ARCHIVES OF OPHTHALMOLOGY

VOLUME 19 (old series Volume 76) JANUARY 1938 NUMBER 1

COPYRIGHT, 1938, BY THE AMERICAN MEDICAL ASSOCIATION

SYNDROME OF GROENBLAD AND STRANDBERG

ANGIOID STREAKS IN THE FUNDUS OCULI, ASSOCIATED WITH PSEUDOXANTHOMA ELASTICUM

J. GOEDBLOED, M.D.

LEYDEN, NETHERLANDS

In the course of the last fifty years various cases of angioid streaks in the ocular fundus have been reported in the literature. In all the cases the fundus showed about the same characteristic picture, consisting of a network of streaks varying in color from reddish to brownish black. As a rule, a more or less complete circular streak surrounds the optic disk at a short distance from its margin. From it mutually allied streaks take their origin; these run more radially and can be followed up to the peripheral parts of the fundus. They lie behind the retinal, and before the larger choroidal, vessels. No connection has been observed between them and one of these vascular systems. The streaks vary much in breadth, broad and narrow streaks being found together in the same fundus oculi. In general their color depends on the abundance of pigment in the fundus. In darker fundi streaks are more brownish black, whereas in lighter fundi they are more reddish brown. Locally they may be lighter, especially where larger choroidal vessels pass behind them. Not infrequently the streaks are framed by small white lines.

In most cases of angioid streaks in the fundus other extensive lesions are found, especially in the macular region. In these cases this region is occupied by a prominent grayish white mass often containing numerous irregular darkly pigmented dots on its surface, thus producing the picture described by Junius and Kuhnt as disciform macular degeneration. Smaller, nonprominent, almost round, white spots are often found in more peripheral parts of the fundus. Many authors described fresh hemorrhages in the retina in the vicinity of, or even in, the macula. In other cases no hemorrhages could be detected. The color and edges of the optic disk are mostly normal; the retinal vessels pass over the streaks without interruption. In general, both retinal and choroidal vessels show no ophthalmoscopically visible alterations, although some authors reported marked sclerosis of the ocular blood vessels. It seems,

From the Department of Ophthalmology, University of Leyden.

however, questionable whether senility rather than the factors producing angioid streaks does not cause the sclerotic changes of the vessels. Certainly sclerotic changes of the ocular vessels are in no way typical of the fundic picture in cases of angioid streaks in the fundus.

Since the first description by Doyne (1889) about 140 cases of this condition have been reported in the literature. Both eyes are always involved, though the lesions are mostly not symmetrical. The cases are about equally divided between males and females (in 134 reported cases, 76 of the patients were males and 58 females). Most patients come under observation at middle age because of blurred vision, though many younger persons with this condition are seen. Bachsinjan-Frenkel in 1927 reported a case of angioid streaks in the fundus oculi in a 9 year old girl.

Histologic examination in clinically observed cases has failed for a long time to reveal the cause of the streaks. Accordingly, different hypotheses have been given to explain this interesting fundic picture. Plange in 1891 stated the belief that the angioid streaks are hemorrhages. It must be noted, however, that existing streaks are never resorbed, as often happens in the case of hemorrhages. The idea that the pigmented lines are caused by newly formed vessels was put forward by Lister in 1905. Objections to this opinion were the varying breadth of the streaks and the absence of any visible connection between them and the ocular vessels. The streaks have also been interpreted as folds of the choroid or the retina (Walser [1895]; Quist [1921]; Verhoeff [1931]). The most probable explanation was given by Kofler in 1916, who expressed the belief that the streaks are ruptures in the lamina vitrea (Bruch's membrane). At the meeting of the Dutch Ophthalmological Society in December 1936 Hagedoorn reported the results of histologic examination in a clinically observed case of angioid streaks in the fundus. The microscopic sections of the eyes demonstrated marked thickening of the lamina vitrea, which stained intensively with hematoxylin. Various fine ruptures could be seen in it, while in many places the lamina vitrea was completely absent over longer distances. In this connection it is noticeable that Behr in 1929 and 1931 demonstrated degeneration of the lamina vitrea in disciform macular degeneration, which, in his opinion, should be considered the causal factor of the changes in the macular region.

Groenblad in 1929 reported 2 cases of angioid streaks in the fundus in which the patients showed a typical lesion of the skin which was determined by Strandberg to be pseudoxanthoma elasticum. Pseudoxanthoma elasticum is a rare lesion of the skin first described by Darier in 1894 and consisting of yellowish white, somewhat papulous spots, especially on the throat and in the axillary and the inguinal region. Microscopic sections of the skin show typical changes in the elastic tissue of the middle and the deeper layer of the cutis, consisting of the

presence of numerous large lumps of elastin, while a normal elastic fibrillar structure is absent. The epidermis, the stratum papillare and the subcutis are usually not involved. I could gather 67 instances of angioid streaks in the fundus from the literature in which the skin was examined for pseudoxanthoma elasticum. In 57 cases the typical lesion of the skin was present; in 2 cases senile elastosis was found. In senile elastosis the elastic and the collagenous connective tissue of the skin are both degenerated. In 8 cases no typical lesions of the skin were found.

From this it could be concluded that in almost every case angioid streaks are the ocular manifestations of a more general disease involving probably especially the elastic connective tissue and producing pseudoxanthoma elasticum in the skin. In this connection it is also of importance that on obduction in a case of pseudoxanthoma elasticum (reported by Balzer) yellow spots were observed in the endocardium. The histologic examination showed a lesion of the elastic connective tissue similar to that present in the skin. Groenblad in 1932 discussed the possibility of similar alterations of the connective tissue in the walls of the blood vessels. Such lesions should be able to explain the tendency to hemorrhages in the fundus oculi in cases of angioid streaks. Verhoeff in 1931 reported a case of angioid streaks in the fundus combined with osteitis deformans (Paget's disease of the bones). Since then 7 cases of this combination have been published. It is noticeable that in those cases no pseudoxanthoma elasticum could be found. In connection with this it is possible that, apart from the syndrome of Groenblad and Strandberg, a second syndrome may exist in which angioid streaks in the fundus are found together with osteitis deformans but without pseudoxanthoma elasticum. A combination of both syndromes has not yet been reported.

The deeper causes of angioid streaks in the fundus have been obscure for a long time. Causal relations to any acquired disease were never found. Many authors, however, reported familial occurrence of the disease, which points to heredity as being the probable causal factor. De Schweinitz (in 1896 and 1897) saw angioid streaks in the fundus in 2 brothers. Cases of familial occurrence have since been described by Spicer (1914), Lindner (1914), Lederer (1921), Wildi (1926), Morgan and Batten (1931), Clay (1932), Hartung (1932), Sugg and Stetson (1934), Blobner (1935), Böck (1935) and Matras (1935). The first report of a more complete examination of a whole family for angioid streaks in the fundus, with remarks on the genealogic relations, was given by Hartung in 1932. He found 2 persons with angioid streaks of the fundus in one generation of 7 persons. The parents, both healthy, were blood relations. Consanguinity between the parents of

patients with angioid streaks in the fundus was also reported by Matras in 1935 and by Franceschetti and Roulet in 1936.

A case of angioid streaks in the fundus observed at the department of ophthalmology of the University of Leyden and reported in detail as follows was in many respects of special interest. In this case I had the opportunity to observe the patient for about six months, during which the development of the typical macular changes could be clinically pursued. Further, a complete examination of the whole family, comprising 26 persons divided over four generations, was made.

REPORT OF A CASE

History.—A man aged 46 years visited the outpatient department of the University Eye Hospital on Oct. 26, 1936, because of marked decrease in the vision of the left eye. The condition began fourteen days before with symptoms of metamorphopsia and photopsia. Vision of the right eye had been very poor since a blow against this eye fourteen years previously. The patient further stated that one of his elder sisters, who had lost her vision some years previously, had had identical symptoms.

Examination of the Eyes.—Vision of the right eye was 1/120; there was no improvement with glasses. Refraction showed emmetropia. Vision of the left eye was 3/10; there was no improvement with glasses, and refraction showed emmetropia. External examination of each eye and examination of the optic media showed nothing abnormal.

Fundus of the Right Eye (fig.1 *A*): The almost normal optic disk was surrounded by a broad pigmented streak, from which numerous other pigmented lines and stripes took their origin, covering the whole fundus oculi, thus producing a picture much resembling that of cracked glaze. The streaks were bordered by small white lines. In the streaks the pattern of the choroidal vessels was much more pronounced. The macular region was occupied by a prominent white mass which was covered by dark pigmented dots. The finer branches of the retinal vessels passed over the tumor. Only a single bright white spot was seen outside the macula, while the peripheral parts of the fundus were covered by numerous brown spots. The retinal and the choroidal vessels showed no alterations; hemorrhages were absent.

Fundus of the Left Eye (fig. 1 *B*): A network of angioid streaks similar to that found in the right eye was present in the left. The region of the macula showed a flat detachment of the retina without any tear. Some round, white spots were seen just outside the macular region. Fresh hemorrhages were absent.

Diagnosis: The condition was diagnosed as angioid streaks in each fundus oculi.

Examination of the Skin.—In the skin of the throat and of the axillary, inguinal and abdominal regions several yellow-white spots were found. Histologic examination showed typical degeneration of the elastic connective tissue of the cutis. The diagnosis was pseudoxanthoma elasticum (Dr. Dethmers).

Further Examination.—Roentgenograms of the skull, the spinal column and the pelvis showed no evidence of osteitis deformans.

The medical consultant found no signs or symptoms suggestive of any internal disease, except a slight rise of the blood pressure (160 systolic and 90 diastolic), for which no cause could be found.

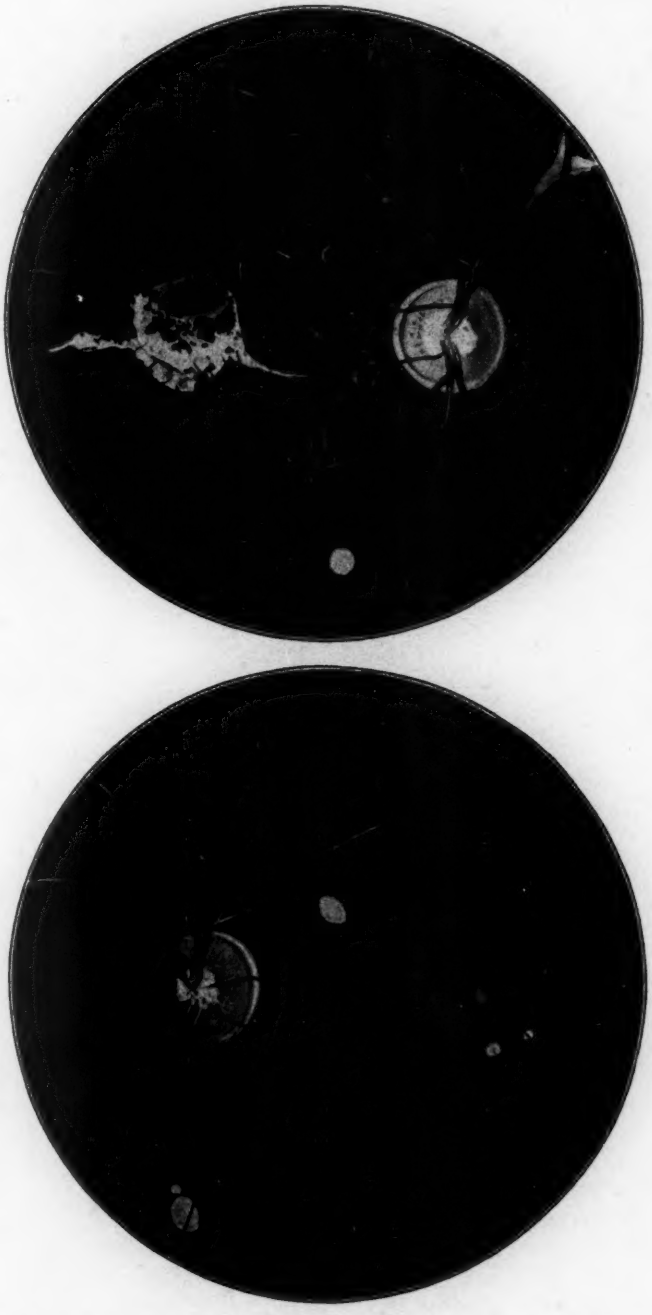


Fig. 1.—*A*, fundus oculi of the right eye. *B*, fundus oculi of the left eye.

So it was evident that the patient showed the typical syndrome of Groenblad and Strandberg.

Treatment.—The patient was then treated with sodium salicylate and sodium iodide alternately, in the hope of bringing about regression of the macular detachment.

Subsequent Course.—On Jan. 21, 1937, vision of the right eye was the same as formerly. Vision of the left eye was 7/10. In spite of the improved vision, metamorphopsy and photopsy had persisted. In the macular region the flat detachment was still present, with slight irregularities in the distribution of the retinal pigment.

On February 22 the patient stated that since the last examination he had noticed decrease in the vision of the left eye, with increased photopsy. Vision of the right eye was the same as formerly. Vision of the left eye was 1/30. Ophthalmoscopic examination showed a protruding detachment of the retina in the macula. The center of the detached macula was taken up by a yellowish

Fig. 2.—*A*, macula of the left eye, showing retinal detachment. *B*, macula of the left eye, showing prominent disk.

brown spot, which probably represented the macular pigment (fig. 2*A*). On the lower side of the macula two fresh hemorrhages were seen. The patient was admitted to the hospital to undergo a perspiration cure.

On March 19 there was no change in the vision of the right eye. Vision of the left eye was 1/24. Distinct changes had taken place in the macular region, in which a rather strongly marked, less prominent grayish disk was seen. The hemorrhages were still present (fig. 2*B*).

In this case the changes of the macular region showed the typical progression which was first described by Wildi in 1926. This author distinguished three stages in the development of the lesions in cases of angioid streaks in the fundus. In the first stage angioid streaks are found without any visible lesion of the macula and associated with normal central vision. The second stage sets in with a rather sudden decrease in visual faculty, which, according to Wildi, is due to detachment of the retina in the macular region. The detachment is caused,

in this author's opinion, by a subretinal transudate. In some cases the second stage is preceded by trauma of the eye. In the third stage the transudate is organized by connective tissue, and a pale grayish macular disk is formed.

These typical changes of the second and the third stage could be followed clearly in the left eye of the patient whose case is reported here, while in the right eye the condition had reached the third stage long before the patient was seen.

Examination of the Family.—Four generations of the family could be examined. In the first generation, only the mother of the patient was still alive. She had no angioid streaks in the fundus and no lesions of the skin as seen in pseudoxanthoma elasticum, and roentgenograms showed no signs of osteitis deformans. The father had died at the age of 63 years. Till his death some years previously he had had good vision and had been able to read small print without any diffi-

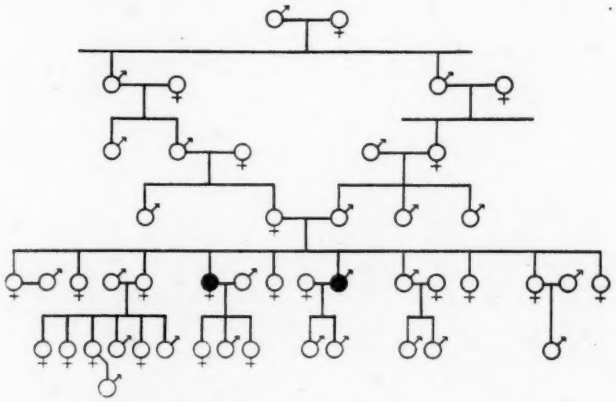


Fig. 3.—Pedigree of the patient's family.

culty, so one may believe that he also had no angioid streaks in the fundus. Further, it must be noticed that the father and the mother were cousins twice removed, as is shown by the pedigree (fig. 3).

The second generation included 10 members (2 males and 8 females). In this generation 8 persons (1 male and 7 females) were free from angioid streaks in the fundus, as was shown by ophthalmoscopic examination, and pseudoxanthoma elasticum was absent.

However, a sister of the patient showed the fully developed syndrome of Groenblad and Strandberg in the same manner as her brother. A brief report on this patient follows.

The patient, a 47 year old married woman, had vision in the right eye of 1/60; there was no improvement with glasses. Vision of the left eye was 1/10, and there was no improvement with glasses. The fundus of each eye shows numerous angioid streaks, with an extensive disciform macular lesion and disseminated white spots. Examination of the skin showed pseudoxanthoma elasticum. Roentgenograms of the skull, the vertebral column and the pelvis showed no signs of osteitis deformans.

In the third and the fourth generation, including 15 children (9 boys and 6 girls) no member showed any symptom of the disease.

As two blood-related healthy parents had among their 10 children 2 with the syndrome of Groenblad and Strandberg, while in the third generation all the members were healthy, it may be concluded, in agreement with Franceschetti and Roulet (1936), that this syndrome is due to a recessive hereditary factor.

SURGICAL TREATMENT OF LACRIMATION

H. ARRUGA, M.D.
BARCELONA, SPAIN

TRANSLATED BY SANFORD R. GIFFORD, M.D., CHICAGO

Lacrimation is an irregular symptom, sometimes very troublesome and sometimes well tolerated. Some patients are easy to cure, while others with the same history resist all treatment.

When a patient presents himself to the ophthalmologist complaining of lacrimation it is the prognosis which is most difficult to make. The lacrimation may be cured with a single probing, or it may not be relieved after several probings and a long course of treatment. Often lacrimation of several months' or years' standing yields to the first probing, while that of only a few days' duration resists prolonged treatment. Slight lacrimation may even be aggravated by the simplest and most prudent explorations.

The means of exploration, aside from irrigation and probing, such as roentgenography and rhinologic examination, seldom afford more information for the prognosis. This is due, probably, to the fact that the arrangement of the lacrimal passages allows the development of latent processes which do not manifest themselves till the moment when the obstruction is complete. Consequently obstruction without marked lesions may be produced, resulting from recent inflammation of the nasal mucosa or due to a chronic inflammatory process that has existed for years.

For best results it is advisable in cases of simple lacrimation to attempt a prudent exploration. First a few drops of cocaine hydrochloride is instilled into the eye. After a few seconds the instillation is repeated. After this one dilates the lower canaliculus slightly with a conical dilator and injects 2 or 3 drops of cocaine hydrochloride. The solution may pass into the nose, for there are cases of lacrimation without complete obstruction. If this happens it will be prudent to employ, for the moment, only irrigations with physiologic solution of sodium chloride or with very mild antiseptic solutions and to advise the patient to consult a conscientious rhinologist.

If this treatment gives no results within a few days, one attempts to pass a fine probe. But one must avoid complete probing at once, that is, passing a probe directly into the nose, for there are many cases in which the obstruction is not in the nasolacrimal duct but at the entrance or

outlet of the lacrimal sac. One begins by probing into the sac and then employs irrigation, noting if the fluid passes more easily than before the probing. If this is the case, one watches for the effect of this treatment; if the patient still complains of lacrimation, one repeats the same treatment. If, after probing into the sac, fluid still passes with difficulty, one must probe a little farther, pushing through the sac into the nasolacrimal duct without going into the nose, for the obstruction is often at this level. The probe is removed, and irrigation is again attempted. If fluid passes easily and a certain resistance has been felt at the outlet of the sac, the same treatment is repeated every three or four days until relief is obtained or for two to three weeks. If, after having passed the outlet of the sac, fluid does not pass freely, complete probing into the nose must be employed.

It is always well to add a few drops of cocaine hydrochloride to the saline solution injected, in order to obtain slight anesthesia of the lacrimal passages. Care must be taken (a precaution often neglected) to adapt the form of the probe to the anatomic position of the nasolacrimal duct and the upper border of the orbit, which varies in different persons. Probes are often too straight and at the moment of entering the duct tear the mucosa of its posterior wall. When the probe has entered the nose it is necessary that it shall exert no pressure on the upper orbital margin, for such pressure indicates that it exerts a corresponding pressure below. It must rest lightly, as if floating. Probes should have, as a rule, a curve more pronounced than is customary.

It may be supposed that fluid has not passed into the nose at the first exploration. One then proceeds with probing by progressive stages, followed by injections of a slightly anesthetic solution, made first into the sac and finally into the nose. The principle is to go no farther with the probe than is necessary. One is surprised at the frequency of obstruction at the outlet of the sac and, sometimes, at its entrance.

If, after several probings either with or without irrigation, a cure is not obtained, it is difficult to obtain one by repeated probing; it is necessary to employ other surgical methods, which will be discussed later. If, instead of simple lacrimation, there is lacrimation plus suppuration, cure by probing is difficult to obtain. One may attempt, however, several probings and irrigations, which, while offering little chance of success, improve the lacrimation by diminishing the infection. In the great majority of cases it is necessary to employ more efficacious methods.

A separate chapter is presented by cases of congenital lacrimal obstruction in the new-born. As will be understood, complete probing employed prudently is necessary, since the obstruction is at the nasal opening of the duct.

STRICTUROTOMY

Stricturotomy, which was emphasized by Poulard, sometimes gives good results. It consists in opening widely the lower canaliculus to permit the passage of a large probe, or even of a rubber probe, which is left in place for several days. The procedure is simpler than the operations which will be described, but the results are slower and less certain. In addition, it leaves the canaliculus too widely opened.

EXTIRPATION OF THE LACRIMAL GLAND

I speak of this operation only to emphasize the fact that it has not given encouraging results in my hands. Furthermore, I have observed several cases of excessive dryness of the eye resulting from the operation. Other methods of treatment, such as obstruction of the excretory ducts of the lacrimal gland by cauterization, electrolysis of the gland or diathermic punctures, are not to be advised.

EXTIRPATION OF THE LACRIMAL SAC

This is the operation still most frequently performed for lacrimation. It has the advantage of being easy, rapid and simple. On the other hand, it leaves a definite lacrimation which is very annoying, especially to nervous and highly cultured persons. Nevertheless, there are persons who do not appreciate the value of relief from lacrimation, who are not interested in a more painstaking operation and who ask only relief from their ocular irritation. Such persons, when one proposes dacryocystorhinostomy, stating that it will relieve both suppuration and lacrimation, reply that the eye is no longer watering, although a tear may be seen on the cheek. In such cases it is not worth the trouble to perform a difficult operation of which the patient neither sees the purpose nor appreciates the advantages.

There are other cases in which extirpation of the sac should be advised. These are cases in which the patient is to undergo an operation for cataract soon after. There are ophthalmologists who consider the security against infection greater after extirpation than after dacryocystorhinostomy. For my part, I may state that I have operated for some thirty cataracts in patients who have had dacryocystorhinostomy, without the slightest infectious complication.

DACRYOSTOMY (DACRYOCYSTORHINOSTOMY)

The real progress in the treatment of lacrimation resulting from obstruction of the nasolacrimal duct is due to the operation which replaces the nasolacrimal duct by an opening through the bony wall between the lacrimal sac and the nasal cavity. Toti deserves the honor of recognition as first doing this operation. But technic and equip-

ment were not perfected so as to give a large percentage of cures. Dupuy-Dutemps and Bourget, in France, and Ohm, in Germany, have done most to perfect the technic and to increase the percentage of cures.

Toti perforated the bony wall and removed the inner wall of the sac. In the majority of cases the nasal mucosa later closed the opening made; sometimes it adhered to the mucosa of the lacrimal sac, and permeability was assured. The authors who have perfected the operation have facilitated joining of the nasal to the lacrimal mucosa by suturing the two membranes.

The operation is not simple. It is one of the most difficult in ophthalmologic practice, but the difficulties are relatively easy to conquer if one persists in following certain rules which experience has shown to be indispensable. A description of the operation follows.

Preparation of the Patient.—Little preliminary care need be given the patient. If he is very nervous it is well to give phenobarbital or barbital or even to inject morphine hydrochloride or an opium preparation. If he is a hemophiliac, for two days beforehand one gives from 2 to 3 Gm. of calcium chloride and before the operation an injection of 1 Gm. of the same drug with a similar dose of a coagulant.

Anesthesia.—Local anesthesia is nearly always sufficient. Some confrères prefer to anesthetize their patients more or less completely with rectal injections of tribromethanol in amylene hydrate or to obtain a degree of somnolence with large doses of hypnotics.

For local anesthesia a 2 to 3 per cent solution of procaine hydrochloride with epinephrine hydrochloride is employed. Three cubic centimeters of the former with from 10 to 12 drops of the latter is the best solution to use, for it is well to utilize the ischemic properties of epinephrine to a greater extent than is obtained by the solution employed by general surgeons, who inject greater quantities of the solution. From 12 to 15 drops of epinephrine hydrochloride is always well tolerated. In elderly persons and in persons with cardiovascular disease it is prudent not to give more than from 5 to 6 drops. One injects this solution with a blunt needle (for a sharp needle easily perforates the veins, which are abundant in this region) into the upper inner angle of the orbit to a depth of 2 cm. so as to reach the neighborhood of the anterior ethmoidal foramen. One cubic centimeter is injected here. The needle is withdrawn, and a few drops is injected under the skin of this region. Without being removed, the needle is passed internally to the bone, where 0.5 cc. in injected. The needle is withdrawn, and one presses the thumb on the region of the injection, moving it against the finger downward and attempting to displace a part of the injected fluid toward the inferior lacrimal region. Another puncture is made in this region toward the angle formed by the inferior and inner walls of the orbit, where 1 cc. of solution is injected. The needle is with-

drawn, and pressure is made over this region. On the side of the nasal mucosa anesthesia is obtained by equal parts of a 4 to 5 per cent solution of cocaine hydrochloride and a 1 : 1,000 solution of epinephrine hydrochloride. This may be applied with an atomizer or by cotton pledgets attached to a thread from 10 to 15 cm. long, which are placed in that portion of the nasal region corresponding to the lacrimal sac. The threads are left hanging from the nostril so that the pledgets may be easily withdrawn. During anesthetization of the nasal mucosa the patient remains seated, with the head held forward so that the solution does not enter the throat.

Anesthesia is immediate, and the operation may be begun at once.

Incision.—This is made as for extirpation of the sac, that is to say, from 2 to 3 cm. from the inner angle of the eye and from 2 to 3 cm. long. One seeks the internal canthal ligament, which is dissected to its bony attachment, which is later detached from the bone with the rasp. The speculum of Müller with pointed hooks is put in place, and the sac, which is always behind the ligament, is separated from the bone. If certain vessels bleed excessively one attempts to catch them with the hooks of the speculum. The tampons are withdrawn from the nose.

Perforation of the Bone.—For this procedure one of two methods may be employed. One may use a mallet and chisel or a trephine and bur. The first method is easier, but slower and more disagreeable for both the patient and the physician.

If one employs a mallet and chisel, one begins by removing the lacrimal crest, for it is here that the bone is thickest. The thickness of the bone varies greatly in different persons, and one must be very careful not to wound the nasal mucosa. At the site of the unguis one must count on extreme thinness of bone and often on the presence of ethmoid cells. The bony opening must be large, about 1.5 cm. in diameter. When the nasal mucosa is well exposed in the opening, the operation is continued as will be described.

If perforation with the trephine is employed, one must use a trephine with a center pin to prevent slipping (fig. 1). When this trephine has been applied for ten to fifteen seconds, it is replaced by one without a center pin, which is applied in the groove made by the first trephine. During the trephining it is necessary to protect the sac by a bent spatula. One must lean with the hand holding the trephine on the patient's head. In this way when perforation of the bone occurs one will not enter the nasal cavity abruptly. It is prudent to test, from time to time, with a small elevator, the mobility of the osseous disk to avoid wounding the nasal mucosa and to determine the point where perforation first occurs. Sometimes one sees in the depth of the furrow a little blood coming from the mucosa, which indicates the necessity of raising the bony disk with the elevator and of not continuing with the trephining,

for in many cases one does not reach the mucosa in the whole extent of the furrow at the same time. The thickness of the bone being variable, one of the sides may be perforated while on the other side there remains a layer to trephine. But with the elevator the part not perforated breaks easily.

One may enter completely or partially into ethmoid cells. In this case one separates the lamellae forming the walls of these cells with a sturdy forceps having broad points. This may also be done with the spatula used to protect the sac. In any case, one must try to expose the mucosa without wounding it. To determine whether one has

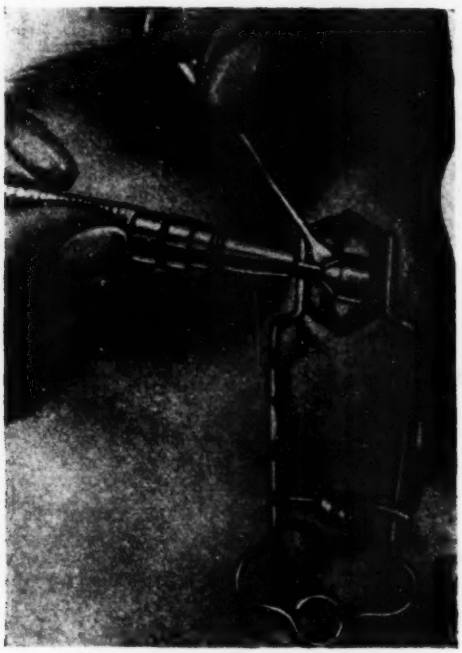


Fig. 1.—Opening in bone being made by trephine.

reached the mucosa of the nasal cavity one may introduce an instrument into the nose, directed toward the field of operation.

At this moment it is necessary to enlarge the bony opening, which may be done with a cylindric or spherical bur. A convenient instrument for this purpose is the bur of Gutzeit. This permits enlargement of the opening, while the mucosa is protected.

It is of advantage that this enlargement of the opening be made especially on the nasal side, by beveling the bony opening; thus the opening will have a conical form, and the mucosa will approach the sac at an obtuse angle instead of a right angle. This favors also the movement of the mucosa toward the sac in parts of the opening which are not covered by sutured mucosa.

If in perforating the bone one has wounded the mucosa, it is sometimes impossible to make the sutures which will be described. One must adapt one's procedure to the lesion produced. If the mucosa in the anterior part is wounded, a posterior suture is made with the flap of the mucosa existing, and one tries to obtain an anterior flap by enlarging the bony opening anteriorly. If, on the contrary, the mucosa in the posterior part is wounded, one does the same, procuring a posterior flap. If the mucosa is sectioned in its entire circumference, one must content oneself with freeing, as well as possible, the flaps of mucosa by enlarging the bony opening. In any case, it is necessary to make a beveling as large and as perfect as possible.

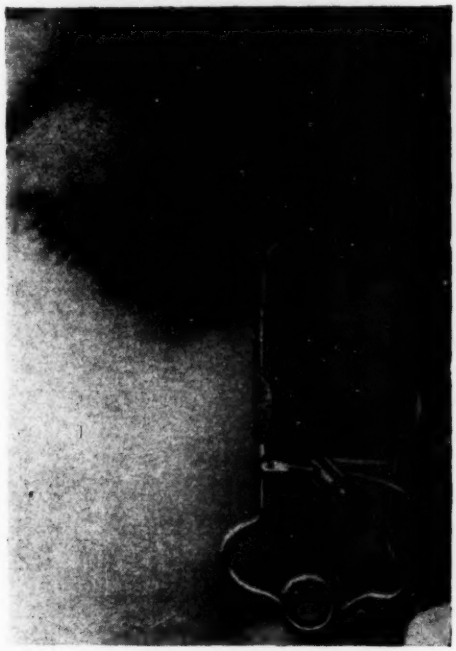


Fig. 2.—Opening enlarged by bur; incision in lacrimal sac.

When a flap of mucosa barely suffices to reach the flap of the sac, one may make an incision in the peripheral part of the flap at the level of the bony margin. In this way the central part of the flap may reach the sac, which facilitates making the sutures. The flap thus cut at its base forms a bridge, but this has no disadvantage.

Opening of the Lacrimal Sac and Nasal Mucosa.—When the nasal mucosa is ready and free along the whole length of the bony opening, the lacrimal sac is cut vertically; sometimes it is useful to introduce a probe through the inferior canaliculus in order to be sure of one's position. Then the posterior flap is grasped with a forceps and drawn

toward the nasal mucosa. At the place where these two membranes touch an incision is made in the nasal mucosa, in the same direction as, and parallel to, the incision of the sac, reaching to the edges of the bony opening (fig. 2).

Suture of the Mucous Membranes.—One now has two posterior and two anterior flaps, one belonging to the sac and one to the nasal mucosa in each region. For the sutures one may employ a needle of Deschamps, or needles that are smaller but of the same type, such as have been devised by various confrères. I use very small curved needles in a needle holder with a curved and delicate tip, with which I reach

Fig. 3.—Suture of lacrimal sac and nasal mucosa; posterior sutures tied; anterior sutures being placed.

easily the deeper structures. Silk is preferable to catgut for the sutures. I employ no. 0 or no. 00 silk.

One must naturally begin with the posterior sutures, following these with the anterior ones. One may usually place three sutures in each region. If the sac is very small it is necessary to be content with two, while when it is very large four sutures may be placed on each side. It is necessary to remove the speculum before tying the anterior sutures (figs. 3 and 4).

Suture of the Skin.—The external suture may be made by the customary methods. I employ a continuous suture, for with this there

is no tendency of the borders of the wound to gap. It is only necessary to take care that approximation of the edges is exact (fig. 5).

Dressing.—It is well to apply an ointment to the region of the operation so that the dressing will not stick to it. Light pressure on the region is also favorable. The dressing is applied, as is customary, with a bandage, in order to exert pressure on the region, which is obtained with adhesive tape. Attention must be paid that the eye remains well closed. A little cotton is placed in the nostril on the side on which the operation has been performed, which is retained for the remainder of the day. It may be necessary to change this from time to time. During

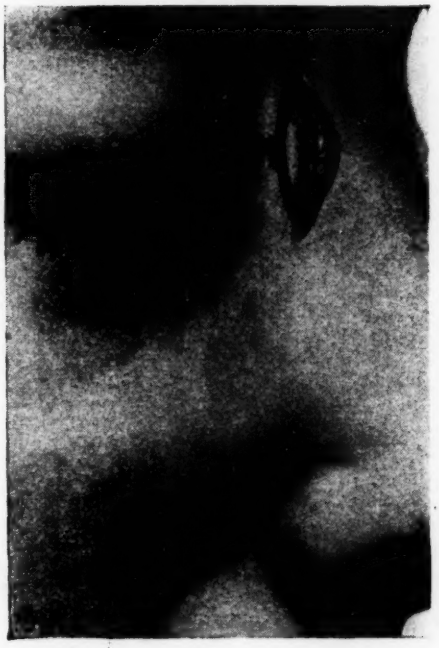


Fig. 4.—Sutures completed.

sleep it may be removed, and on the following days there is no need of it, unless the nose bleeds, which is seldom the case. It is rare that a copious hemorrhage occurs. In case it does, gauze soaked in petrolatum is packed in the region of the nose in which operation has been performed. Or one may employ small cotton tampons attached to a thread which passes out of the nostril, the pledgets being soaked in oil so they will not adhere to the region of the operation. Hemorrhage stops at once, for the bleeding area is compressed by the gauze or cotton which is held between the septum and the operative field. One may, especially if the patient is a hemophiliac, take general precautions, using calcium chloride and coagulating agents.

After two days one removes the tampon, and generally there is no more bleeding. If it does occur, the application of tampons must be prolonged, but this is rarely required.

Postoperative Treatment.—It is not necessary that patients be hospitalized for this operation, but the dressing must be changed daily. Prudent irrigations of the sac are favorable. One should not inject antiseptic solutions which may infiltrate the tissues and provoke troublesome edema. It is best to employ physiologic solution of sodium chloride. The second dressing need not exert pressure like the first. One repeats the treatment for several days. On the fourth day the

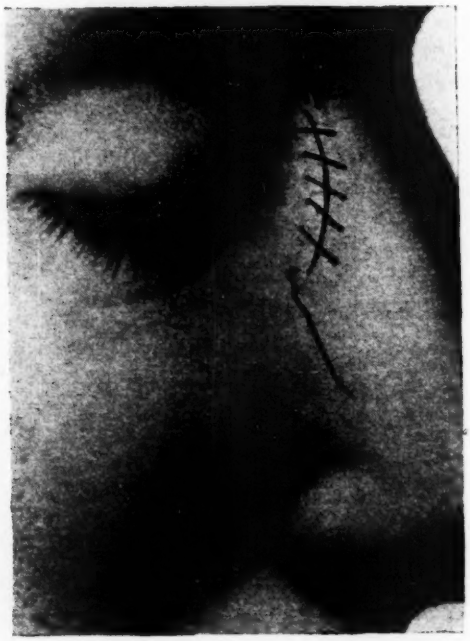


Fig. 5.—Skin closed by running untied suture.

cutaneous suture is removed, and no dressing is employed. The patient is advised against blowing the nose strongly, which may result in emphysema of the region of the operation. If during the treatment it is noted that fluid injected through the canaliculus does not escape into the nose, prudent probing is employed, the probe being passed directly toward the bony opening and an attempt being made to find the opening in the mucosa and to free it by movements of the probe.

Results.—In almost all cases the result is favorable, especially if one has been careful not to wound the sac or the nasal mucosa, if a large bony opening has been made and if the sutures have been correctly placed. Even the presence of ozena constitutes no contraindication.

All operators have had favorable results in cases in which there were marked changes in the nasal mucosa. The percentage of cures is more than 95.

Recurrence.—In certain cases an obstruction of the opening may occur during the first few weeks or months after the operation, rarely after two or three months. In such cases it is necessary to perforate the membrane which closes the opening. For this purpose one anesthetizes the nasal mucosa as for the aforedescribed operation and injects cocaine hydrochloride and epinephrine hydrochloride into the sac. The lower canaliculus is dilated with probes of increasing size. When a no. 5 or no. 6 probe passes, one leaves it in place for several minutes. Then a Weber knife is passed by the same route, being introduced with a little force through the membrane, and an incision from above downward is made to form a buttonhole in the membrane. One may also

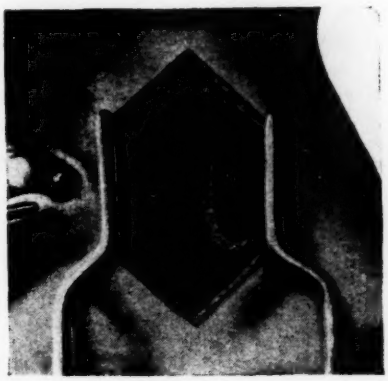


Fig. 6.—Operation when lacrimal sac has been removed; incision in wall of canaliculus, showing probe.

open the membrane transversely. The knife is withdrawn carefully, with the back resting on the wall of the canaliculus. In most cases lacrimation stops after this operation, for the buttonhole produced in the membrane suffices for drainage. This is favored by the tendency of cicatricial tissue to retract.

OPERATION IN CASES OF ABSENCE OF THE LACRIMAL SAC

In cases in which the lacrimal sac has been removed it is possible to obtain reestablishment of lacrimal drainage into the nose by dacryostomy. It is surprising that such a result can be obtained when there is no sac which may be sutured to the nasal mucosa, but the facts show that it is possible. If the lower canaliculus is in good condition in its whole length the operation is a success in two thirds, or even three fourths, of the cases. Integrity of the inferior canaliculus is indispensa-

ble for the operation. Bone that is not too thick and ethmoid cells that are not too large are favorable, since thick bone and large ethmoid cells separate the nasal mucosa from the end of the canaliculus greatly.

The technic of this operation does not differ greatly from that already described. I shall mention only its special points.

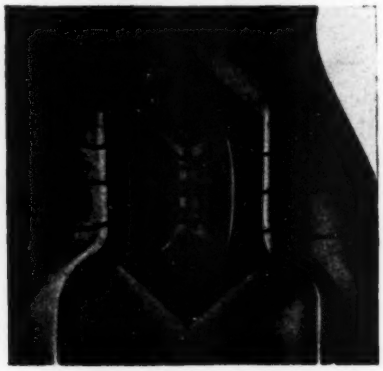


Fig. 7.—Sutures between canaliculus and nasal mucosa.

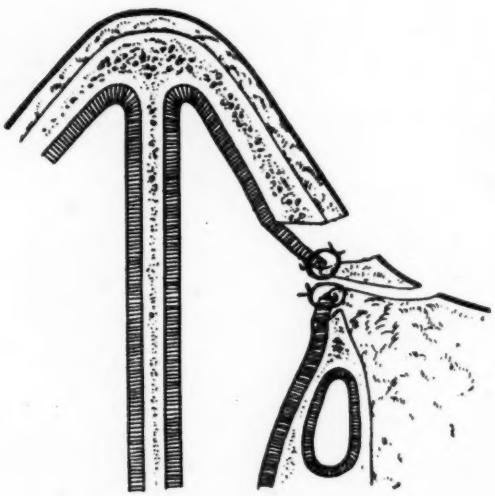


Fig. 8.—Diagram of sutures.

Incision of the Skin.—This is made in the customary place, but, as there is no sac, one finds in its place only scar tissue. This is traversed by the incision close to the bone as far as the posterior lacrimal crest or the posterior part of the lacrimal fossa.

Perforation of the Bone.—This is performed as already described. One must not fail to make the opening large, for in this case one must go far to reach the nasal mucosa, and the larger the opening the easier it is to make it reach the canaliculus.

Procuring the External Flaps.—A probe is passed through the inferior canaliculus. Its point makes a prominence in the scar tissue. Maintaining this prominence by pressure with the probe, one cuts the tissue over the point of the probe vertically until the probe appears. The incision is prolonged inward and downward deeply into the scar tissue. A wound is thus obtained formed by two lips or flaps, an anterior and a posterior flap (fig. 6).

Opening of the Nasal Mucosa.—An incision is made in the customary direction but at a point which corresponds as nearly as possible to the incision which has been made on the external wall of the wound.

Suture.—Posterior and anterior sutures are placed as in the classic dacryocystorhinostomy. The posterior sutures unite the posterior flap of mucosa and the posterior lip of the wound previously made. The anterior sutures unite the anterior flap of mucosa with the anterior edge of this wound. Before the latter sutures are tied the speculum is removed (figs. 7 and 8).

Suture of the skin is made as already described.

Postoperative Treatment.—Daily irrigation after previous probing is performed. In general, no difficulties occur. If obstructions of the opening develop, probing may always be attempted and is, as a rule, simple.

GALACTOSE CATARACT IN RATS

FACTORS INFLUENCING PROGRESSIVE AND REGRESSIVE CHANGES

HELEN S. MITCHELL, PH.D.
AND
GLADYS M. COOK, M.S.
AMHERST, MASS.

The observation that galactose is unique as an etiologic factor in the production of experimental cataract in rats was first reported by Mitchell [1] and later confirmed by Yudkin [2] and Day.[3] The earlier work with lactose and other sugars [4] led to the realization that it was probably the galactose fraction of the lactose molecule which caused the injury. Galactose has supplanted lactose for the production of most of the experimental cataracts in the laboratory of the Massachusetts Agricultural Experiment Station because of the more rapid and consistent results obtained. Whichever sugar is used, however, it is logical to speak of galactose cataract in contrast to the vitamin G deficiency cataract. Both may well be designated as nutritional cataracts.

The fact that the rat is susceptible to lenticular changes as a result of vitamin G deficiency or of intolerance for galactose makes it a valuable experimental animal for further study of dietary factors influencing the transparency of the lens. Whether these experimental cataracts are analogous to any recognized clinical types has not been determined but the possibility of experimental production of opacities of the lens under carefully controlled conditions permits a new approach to a baffling subject.

The discovery that a specific carbohydrate intolerance could cause opacities of the lens in young rats led to the use of this experimental device for studying the nature of cataractous changes from several

---

This paper is Contribution No. 281 of the Massachusetts Agricultural Experiment Station.

1. Mitchell, H. S.: Cataract in Rats Fed on Galactose, J. Nutrition (supp.) **9**:14 (June) 1935; Proc. Soc. Exper. Biol. & Med. **32**:971, 1935.

2. Yudkin, A. M., and Arnold, C. H.: Cataract Formation in Rats Fed on a Diet Containing Galactose, Proc. Soc. Exper. Biol. & Med. **32**:836, 1935; Cataracts Produced in Albino Rats on a Ration Containing a High Proportion of Lactose or Galactose, Arch. Ophth. **14**:960 (Dec.) 1935.

3. Day, P. L.: Blood Sugar in Rats Rendered Cataractous by Dietary Procedures, J. Nutrition **12**:395, 1936.

4. Mitchell, H. S., and Dodge, W. M.: Cataract in Rats Fed on High Lactose Rations, J. Nutrition **9**:37, 1935.

angles. Galactose cataract develops most readily in young rats, while adult animals show more resistance to lenticular changes due to a foreign sugar in the blood. This may indicate that the young lens is more easily injured than the old one by chemical changes in the surrounding medium. Certainly the young lens appears to be more susceptible to injury from galactose than other tissues in the body, so far as has been observed. Other than changes in the sugar contents of the blood and urine, no pathologic condition has been evident in these animals, either while they were alive or at autopsy. The conjunctivitis and alopecia which may accompany vitamin G deficiency cataract are entirely absent in these animals. In fact, growth has been normal in all rats fed galactose at various levels (15, 25 and 35 per cent) supplemented with starch in an otherwise adequate ration. Lactose at high levels usually causes diarrhea and some retardation of growth. The experience of Clapp [5] that rats on galactose and lactose rations died before opacities developed is difficult to explain unless the rations were inadequate in some other respect.

SUSCEPTIBILITY OF STRAINS

A variation in the susceptibility of different breeds or strains of rats to galactose cataract [6] and a lesser but nevertheless significant difference between litters are observations which have proved to be of increasing importance in the study and interpretation of accumulated data. Variation in strain must be considered in comparing the results from different laboratories. Variation in susceptibility between litters emphasizes the necessity for carefully controlled experiments with litter mates and the use of several litters of rats when the influence of dietary factors is being observed. The failure of Bellows [7] to use litter mates in making his comparisons materially lessens the significance of his findings.

While the factor of heredity is of interest and importance in interpreting the results of experiments, it does not overshadow the nutritional problem. There is no evidence that even the more susceptible strains of this species (the white rat) show any tendency to the spontaneous development of cataract. During the last fifteen years over six thousand rats from a colony maintained on various types of

5. Clapp, C. A., in discussion on Tassman, I. S.: Experimental and Clinical Studies of Cataract, Arch. Ophth. **17**:948 (May) 1937.

6. Mitchell, H. S.: Susceptibility of Different Strains of Rats to Nutritional Cataract, J. Nutrition **12**:447, 1936.

7. Bellows, J. G.: Biochemistry of the Lens: IX. Influence of Vitamin C and Sulfhydryls on the Production of Galactose Cataract, Arch. Ophth. **16**:762 (Nov.) 1936.

adequate and inadequate diets have never shown visible injury to the lens except on lactose or galactose rations.

STUDIES OF THE SUGAR CONTENTS OF THE BLOOD AND URINE

Determinations of the sugar contents of the blood and urine [8] were made on several series of rats fed rations containing 62 and 70 per cent lactose, 25 and 35 per cent galactose, 35 per cent fructose, 35 per cent xylose and 70 per cent starch. The values for the total blood sugar content were higher for the rats on galactose diets than for those on lactose diets but were above normal for all the animals on cataract-producing rations—in contrast to the normal levels observed with all other carbohydrates. The nonfermentable fraction of the blood sugar (galactose) varied with the amount of lactose or galactose fed, but the fermentable fraction (dextrose) remained nearly constant and within the range of the normal blood sugar content. Galactose was observed in varying amounts in the urine of all the rats on lactose and galactose rations; the content was relatively higher in the urine of the animals fed galactose, and the sugar was absent in the urine of starch-fed control rats. It was concluded that galactose is the sugar responsible for the high sugar contents of the blood and urine of rats fed lactose or galactose rations and must be the major etiologic factor in galactose cataract.

INFLUENCE OF PROTEIN FACTORS IN THE RATION

The ration containing 25 per cent galactose, used in most of our studies,[9] contained 15 per cent protein (casein), 70 per cent carbohydrate (starch and galactose), 11 per cent fat (hydrogenated cotton seed oil and cod liver oil) and 4 per cent salt mixture (Osborne and Mendel). Reduction of the protein content from the regular 15 per cent level to the 5 per cent level shortened the time of the development of cataract from twenty-six to fifteen days, a difference which is strikingly significant. Earlier attempts to alter the speed of lenticular changes by increasing the amount or altering the type of protein yielded negative results, but more recently high protein rations have tended to delay the development of cataract.

Bellows' [7] observation of an inhibitory effect of 0.3 per cent cystine added to a ration containing 35 per cent galactose could not be confirmed. Subsequently larger amounts of cystine (1, 2 and 3 per cent) added to a ration containing 25 per cent galactose did have a slight inhibitory effect. This twenty-fold increase in cystine over the amount

8. Mitchell, H. S.; Merriam, O. A., and Cook, G. M.: The Relation of Ingested Carbohydrate to the Type and Amount of Blood and Urine Sugar and to the Incidence of Cataract in Rats, J. Nutrition **13**:501, 1937.

9. Mitchell, H. S., and Cook, G. M.: The Influence of Protein and Cystine Intake on the Cataract-Producing Action of Galactose, Proc. Soc. Exper. Biol. & Med. **36**:806, 1937.

present in the usual ration had such a minor inhibitory action as to raise the question whether the cystine content of the ration is really a crucial factor in spite of the loss of cysteine in a cataractous lens. Other protein factors are being investigated.

ALTERATION OF OTHER FACTORS IN THE RATION

Clinical experience and chemical analyses of lenses have suggested various factors which might exert an influence on the production of cataract. Various types of supplementary carbohydrates (starch, dextrin, sucrose and dextrose) used with galactose have been tried, without alteration of the speed or incidence of cataractous changes.

The type of fat (hydrogenated cotton seed oil, butter, mutton tallow, cod liver oil) and the amount (2, 11, 22 and 46 per cent) were varied systematically in galactose rations, without appreciable alteration in the production of cataract. An apparent delay with high fat rations fed ad libitum proved to be due to the difference in the amount of galactose actually consumed. A more detailed report on this phase of the work will be published elsewhere.

The cataract-producing action of lactose or galactose was not modified or altered by a variety of other supplements to or modifications of the ration,[10] such as: (1) addition of excess cholesterol (2.5 and 5 per cent), (2) shifting of the acid-base balance (4.76 per cent sodium citrate or 3.4 per cent ammonium chloride), (3) regulation of the amount of water ingested, (4) administration of cevitamic acid orally or injected, (5) deficiency or excess of vitamin B_1 or vitamin B_2, (6) ingestion of large doses of dinitrophenol and (7) administration of protamine insulin.[8]

STAGES OF DEVELOPMENT AND REGRESSION OF CATARACT

1. *Early Lenticular Changes.*—During the past two years all the rats on cataract-producing rations have been examined weekly or semiweekly with an ophthalmoscope for early lenticular changes. In white rats there is so little pigment in the iris that gross changes may be observed through this tissue, but it is far more satisfactory to dilate the pupil. A drop of a 0.2 per cent solution of atropine sulfate administered from twenty to thirty minutes before the examination has been adopted as a satisfactory routine.

In previous attempts to describe these early lenticular changes the investigators failed to follow the sequence of stages accurately, or mention of certain changes were omitted altogether. The frequent

10. Mitchell, H. S.; Cook, G. M., and Merriam, O. A.: The Specificity of Galactose as a Cataract Producing Agent, J. Nutrition (supp.) **13**:18 (June) 1937.

examination of over sixteen hundred eyes by one person has disclosed certain differences between rapidly and slowly developing cataract which warrant more detailed description.

Rats fed galactose show early and rapid lenticular changes varying in proportion to the amount of this sugar ingested or to other relevant factors. The more slowly developing cataracts in rats fed lactose showed fewer of the early changes consistently observed in the galactose-fed animals. In eyes with the rapidly developing type of cataract, as early as the fifth day a narrow, dense shadow is evident in the equatorial region of the anterior cortex. This dense film appears to have a cell-like structure and increases rapidly in extent until the eighth to the twelfth day, when it may cover from one half to seven eighths of the anterior surface of the lens. Slit lamp observations by two ophthalmologists have confirmed our observations.[11] This phenomenon is undoubtedly similar to that recently described by Bellows [7] as a "dark

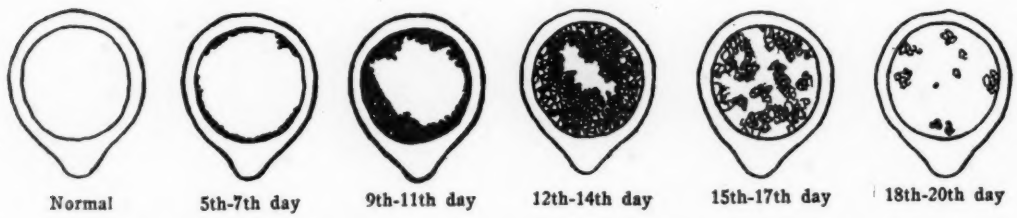


Fig. 1.—Diagram of early changes in the cortex of the lens preceding the development of actual opacities. The sequence is characteristic of a rat on a ration containing 25 per cent galactose. Note the increasing area involved in the first three stages and the scattered transparent masses in the later stages.

reflex with the ophthalmoscope" or a "peripheral opacity" which later became "confluent and extended centrally." All this applies to what we have observed, except that the film seldom covers the entire cortex, and instead of becoming more dense to the point of complete opacity, as Bellows inferred, it has been invariably observed that it becomes less dense after the twelfth to the fourteenth day and later appears as transparent vacuoles scattered singly or in masses over any part of the anterior cortex. The drawings in figure 1 illustrate five stages of this progressive change as seen ophthalmoscopically, showing the increasing area involved in the first three stages and the scattered transparent masses in the final stages. The thinning out and scattering allow observation of the deeper lenticular changes. In the posterior cortex and deeper in the lens substance spokelike or irregular opacities develop

11. Dr. Frank E. Dow, of Northampton, Mass., and Dr. Theodore L. Terry, of the Massachusetts Eye and Ear Infirmary, Boston, have generously cooperated in examinations of the eyes and have read the manuscript of this paper.

rapidly to the point where a dense white nucleus is visible to the naked eye. In almost every case the anterior vacuolated film has disappeared before the true cataract is visible. This early change in the anterior cortex is somewhat commensurate with the degree of injury to the lens as measured by the time required for mature cataract to develop, but it is not considered a sufficiently accurate criterion for comparing the specific effect of various dietary factors. In many cases of slowly developing cataract in lactose-fed rats the early change is absent or inconspicuous. Radial lines deep in the lens may be the first change observed.

2. *Visible Opacity of the Lens.*—The first well defined opacity visible to the naked eye is a posterior opacity, which is usually observed from one to three days before a dense nuclear opacity is

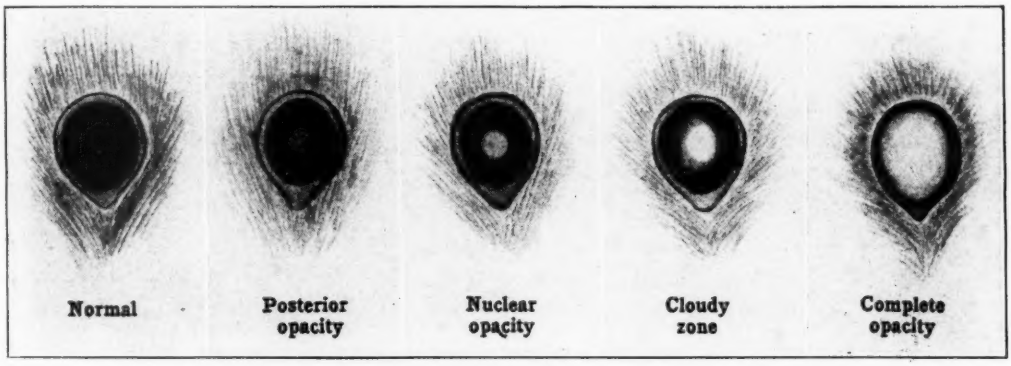


Fig. 2.—Development of visible opacities in a rat fed a galactose ration. The faint posterior opacity changes to dense white in two days or less; then gradually a cloudy zone develops until the entire lens is completely opaque from ten to twelve days later.

seen. If observations are not made daily the stage of the posterior opacity is easily missed. In earlier work the rapidity of these changes was not fully appreciated, and some of the earliest visible opacities were not recorded. The stage of nuclear opacity usually lasts from eight to twelve days, progressing gradually, with the development of a more peripheral cloudy zone, to what has been designated by us as the stage of complete opacity, when the entire lens appears dense white to the naked eye. Four degrees of developing opacity are shown in figure 2, together with the artist's concept of the normal appearance of the lens. This arbitrary division into several degrees of visible cataractous stages has been adopted to facilitate recording of progressive changes. The terms used may not conform exactly to those used in clinical practice but are descriptive of visible changes rather than histologic ones.

A study has been made of our accumulated data to determine the time of the first appearance of the opacity and the duration of the three stages, that of posterior, that of nuclear, and that of complete, opacity. It was surprising to discover that in spite of rather striking differences in the time of the first appearance of the posterior opacity, the change through the nuclear stage to that of complete opacity proceeded at a remarkably uniform rate, regardless of dietary changes.

It might be anticipated that when the aggravating factor (galactose) was omitted from the ration the progress of the cataractous change would be inhibited or stopped altogether. For the majority of the animals the galactose ration was discontinued, because of its expense, as soon as the stage of dense nuclear opacity was reached. In all but a few instances the lenticular changes progressed to complete opacity, regardless of this shift to a "normal" diet. There was apparently a lag in the effect of galactose or else a physiologic sequence of events which, once started, could not be altered. Those rats retained on lactose or galactose rations until after complete opacity had developed were, in general, the more susceptible animals of a litter. The slightly more rapid development of complete opacity in these animals than in those changed to the stock ration at the stage of dense nuclear opacity may have been due to prolongation of the aggravating factor (galactose) in the ration or to greater susceptibility to the lenticular changes. This inevitable progress of the opacity to involve the entire lens prompted further observation as to whether the complete opacity would persist indefinitely.

The table and figure 3 summarize the progressive and the regressive changes observed in five groups of rats on different rations. These groups are subdivided with respect to the stage of development of cataract when the animals were changed to a normal diet; subgroup A was changed to a normal diet during the stage of nuclear opacity, and subgroup B, after the stage of complete opacity was reached. Other experimental findings for these groups on various rations have been published elsewhere, and the results were briefly reviewed earlier in this paper. A study of the rate of the cataractous changes has not previously been reported.

3. *Regressive Changes.*—From the clinical standpoint, cataractous changes in the lens have been considered irreversible. All that nonsurgical treatment of cataract has hoped to accomplish has been retardation of the pathologic changes. So far as is known, no systematic record of any regression of opacities in cases of experimental cataract has previously been reported.

Several series of rats from different experimental groups have been retained on the colony ration or some other normal diet for from

seven to twenty-eight weeks for observation of possible regressive changes. A summary as to the number of rats observed, the rations used and the duration of the different types of opacity is included in the table.

Clearing of the cortex at the equator usually began within three weeks after the stage of complete opacity appeared, provided the rats had been transferred to the normal ration. This apparent regression continued until the dense opacity had receded to a nuclear area similar to the progressive stage described as nuclear opacity. In many of the eyes, however, the dense central opacity became as small as a pin-

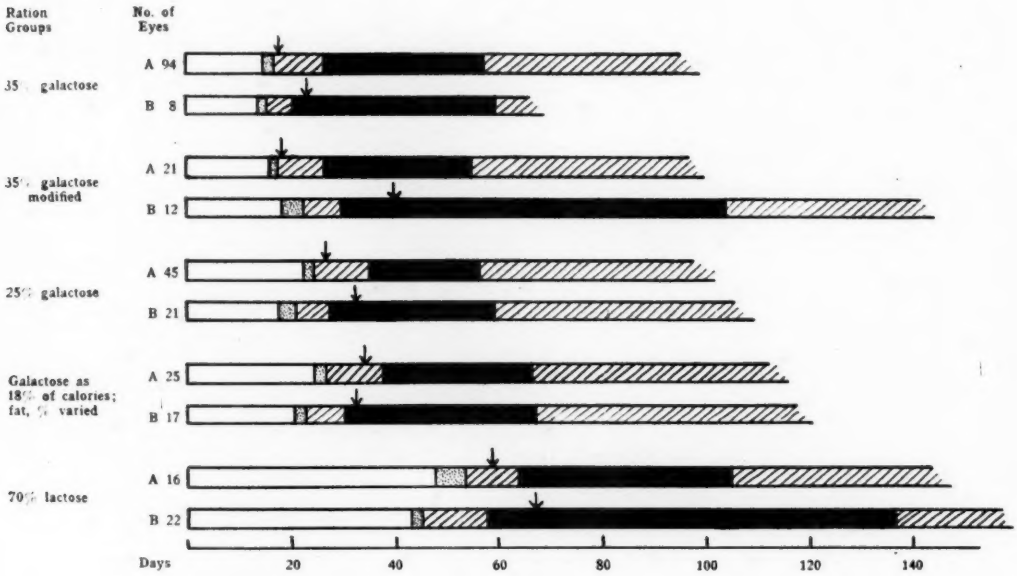


Fig. 3.—Chart showing progressive and regressive cataractous changes in five groups of rats fed different rations. The solid white space indicates no visible opacity; the space with dots, posterior opacity; the space with diagonal lines, dense nuclear opacity, and the solid black space, complete opacity. The arrow indicates change to a normal diet.

head, with the peripheral zone entirely clear. In rare instances this dense white spot seemed to fade until it appeared like an early posterior opacity but was still visible to the naked eye. Drawings to represent certain characteristic stages of regression are shown in figure 4. A cataract which had ever reached the stage of complete opacity never receded to become entirely invisible. So far as has been observed, there is no specific dietary factor that seems to influence materially the speed or the extent of this regression.

A possible explanation of this apparent regression has been suggested. Since the rats were usually 25 days of age when experiments

Stages of Experimental Cataract in Relation to Time

Cataract-Producing Ration	Sub-Group	Number of Eyes Observed	Progressive Changes: First Appearance of Posterior Opacity — Days	Progressive Changes: First Appearance of Posterior Opacity — Probable Error	Progressive Changes: First Appearance of Dense Nuclear Opacity — Days	Progressive Changes: First Appearance of Dense Nuclear Opacity — Probable Error	Progressive Changes: First Appearance of Complete Opacity — Days	Progressive Changes: First Appearance of Complete Opacity — Probable Error	Change to Normal Ration	Regressive Changes: Stage of Opacity When Normal Ration Was Fed	Regressive Changes: Duration of Complete Opacity with Normal Ration — Days	Regressive Changes: Duration of Complete Opacity with Normal Ration — Probable Error	Regressive Changes: Percentage of Eyes Showing Regression
35% galactose	A	94	15.0	± 0.3	17.0	+ 0.2	27.0	± 0.4	70% starch	Nuclear	31.0	± 1.2	93
	B	8	13.8	± 0	14.5	0	20.2	± 0		Complete	36.5	± 0	88
35% galactose + mineral modifications	A		(16.0)†		17.0	0.	28.2	± 0.5	70% starch + mineral modification	Nuclear	29.0	± 2.7	95
	B		(19.9)		22.6	0.9	30.0	± 1.4		Complete	64.0	± 4.3	83
25% galactose	A		22.6	± 0.5	24.6	.9	36.0	± 0.7	70% starch or stock ration*	Nuclear	20.6	± 0.8	100
	B		17.9	± 0.5	20.8	.9	27.5	± 0.6		Complete	27.0	± 2.1	90
Galactose = 18% of calories; fat, % varied	A		25.5	± 0.4	27.1	± 0.4	38.5	± 1.4	Stock ration*	Nuclear	28.1	± 1.4	100
	B	17	20.6	± 0.4	22.5	± 0.4	30.6	± 0.4		Complete	35.4	± 4.6	94
70% lactose	A	16	(48.0)†		54.2	± 2.2	64.5	± 2.0	70% starch or stock ration*	Nuclear	40.7	± 3.1	93
	B	32	(43.0)		44.4	± 1.7	58.3	± 1.8		Complete	69.4	± 4.4	46

* Colony breeding ration adequate for mal growth and reproduction.

† Limited data available—posterior sta not observed.

were started and remained on cataract-producing rations but a few weeks, they were not adult animals when this regressive change was observed. Thus in all probability some normal lenticular fibers capable of growth may have remained at the equator. Such growth would produce clear lens material and tend to cause the opacity to become more deeply placed in the lens. In the group of rats fed the ration containing 70 per cent lactose, cataract developed more slowly than in the others, and the animals were therefore older than the others when the normal ration was resumed. In subgroup B the complete opacity lasted longer and the number of eyes showing regressive changes was less than in the animals of subgroup A, which facts tend to bear out the aforementioned theory in that regressive changes were slower and less evident in these older animals.

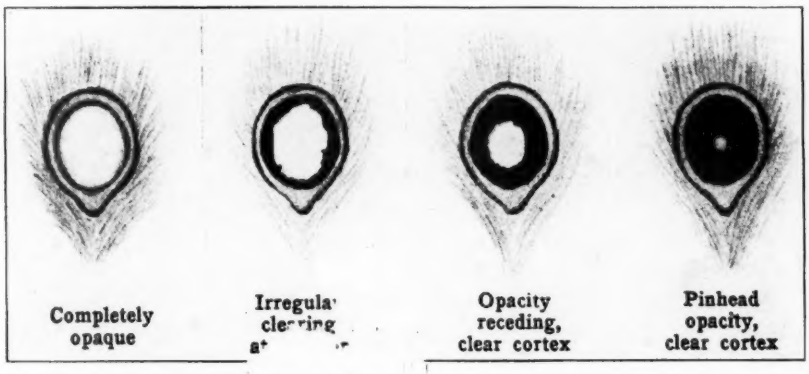


Fig. 4.—Apparent regressive changes in a lens of a rat fed the normal colony ration after cataract had been produced by feeding galactose.

Regressive changes may be related to the degree or the duration of the injury as well as to the age of the animal. The eyes of rats which remained on the cataract-producing ration for several days after the stage of complete opacity had been reached were usually slower to show regression than the eyes of the other rats. The opacities in two such groups were recorded as complete from three to twenty-six days before the change to a normal ration and remained complete for an average of sixty-four and sixty-nine and four-tenths days, respectively, after the change, whereas for corresponding groups changed to a normal ration at the nuclear stage, complete opacity lasted only twenty-nine and forty and seven-tenths days, respectively. Thus it would seem that the severity of the injury may increase beyond that evident from casual inspection and that the prolonged feeding of the aggravating factor may decrease the speed or the extent of regression possible. Sufficient data are not available to warrant any sweeping conclusions on this point.

In a few instances drugs recommended clinically for the nonsurgical treatment of cataract were administered by instillation in suitable dosage to certain rats with mature cataract, while litter mates were maintained as controls. No variation in the rate of regression was observed. Negative results were obtained with thyroxin and with a 1/5,000 solution of mercuric cyanide applied locally. The injection of lens antigen prepared from beef, guinea-pig and rat lenses also failed to exert any noticeable effect.

COMMENT

No systematic review of experimental work on cataract has been attempted in this paper, but rather a brief account of developments in one attack on the subject has been given. Personal conferences and comparison of our results with those of Day, who has published several reports of work on vitamin G deficiency cataract, have failed to uncover a common etiologic factor. The stages in the development of opacities and the final appearance of the mature cataract seem to differ somewhat between the galactose and the vitamin G deficiency type. Discussion and criticism from the ophthalmologist's point of view of the findings reported here will be welcomed. There is no reason to believe that there is any opportunity for immediate clinical application of these findings. As a result of these studies, however, numerous problems of a fundamental nature have arisen and warrant further investigation.

SUMMARY

The rat has proved to be a suitable animal to use for research on cataract because in this species opacities of the lens may develop as a result of certain nutritional disturbances, while spontaneous cataract is rare.

Galactose cataract resulting from feeding either lactose at high levels or galactose at lower levels should be distinguished from vitamin G deficiency cataract. Both may be considered nutritional.

A variation in the susceptibility of different strains of rats to galactose cataract and a lesser but significant variation between litters are of sufficient magnitude to demand the attention of all workers in the planning of experiments and in the interpretation of results.

Studies of the sugar contents of the blood and urine have demonstrated that galactose is the sugar responsible for the high sugar contents of the blood and urine observed in rats fed lactose or galactose rations and that it must be the major etiologic factor in galactose cataract.

One dietary factor which seems to alter the rate of development or the incidence of galactose cataract is protein. A low protein ration (5 per cent) appreciably hastens the development of opacities of the

lens, and a high protein ration and to a lesser extent a high intake of cystine tend to retard this pathologic change.

Other factors, including excess or deficiency of certain relevant vitamins, have failed to alter the cataract-producing action of galactose.

The earliest lenticular change in rapidly developing cataract is a dense vacuolated film originating at the equator and extending over a large portion of the anterior cortex of the lens, which film later disintegrates as large vacuoles and disappears before visible opacities develop.

The successive stages of development of the opacity visible to the naked eye are posterior opacity, dense nuclear opacity and complete opacity. A study of extensive data has been made as to the rate of change and the factors affecting it.

Regression from the stage of complete opacity to that of dense nuclear opacity has been observed in a large proportion of these experimental animals, but no specific dietary factor or local medicament has seemed to alter the speed or the extent of this regressive change. The age of the animal and the extent of the injury, however, do seem to influence the rate of apparent regression of the opaque area.

TUBEROUS SCLEROSIS WITH RETINAL TUMOR

REPORT OF A CASE

FRITZ J. BLOCH, M.D.
NEW YORK
AND
BRUCE A. GROVE, M.D.
YORK, PA.

Probably the earliest record of recognition of cerebral sclerosis associated with retinal tumor was described by von Recklinghausen [1] in 1863. At this time he described having observed a large number of sclerotic areas in the brain of a newly born child and in the same case several myomas growing from the cardiac muscle. Hartdegen [2] in 1881 described a child 2 years old who died in convulsions; autopsy revealed areas of sclerosis throughout the cerebral cortex, as well as a number of small tumors projecting into the lateral ventricles.

Bourneville,[3] in a series of publications between 1881 and 1898, drew attention to a rare form of multiple cerebral sclerosis occurring in young patients who had shown during life mental deficiency and epilepsy. This condition he called tuberous sclerosis. In his subsequent reports covering the autopsies of ten patients he confirmed the association of grayish white subcapsular tumors of the kidney with tuberous sclerosis, and growths were also noted in the heart, spleen and lungs. He also noted in most of his cases the coexistence of adenoma sebaceum, a cutaneous condition described by Pringle [4] as a hyperplasia of certain elements in the skin, distributed in a curious butterfly fashion on the face.

Schuster [5] distinguished five different types of lesions of the skin other than adenoma sebaceum, occurring in tuberous sclerosis, which he considered practically pathognomonic of this disease, namely: (1) gooseskin areas varying in size from that of a quarter to that of half a

---

From the service of Dr. Webb W. Weeks, Department of Ophthalmology, the Bellevue Hospital, New York.

Read at the meeting of the Section of Ophthalmology of the New York Academy of Medicine, April 19, 1937.

1. von Recklinghausen: Verhandl. d. Gesellsch. f. Geburtsch. in Berlin **15**:75, 1863.
2. Hartdegen: Arch. f. Psychiat. **11**:117, 1881.
3. Bourneville: Arch. de neurol. **1**:81, 1880-1881.
4. Pringle, J. J.: Brit. J. Dermat. **2**:1, 1890.
5. Schuster: Deutsche Ztschr. f. Nervenh. **50**:96, 1913.

dollar in the region of the hip; (2) round or oval, pinhead-sized to lentil-sized, grayish yellow, slightly elevated areas on the back; (3) flat, wartlike, lentil-sized formations of normal color or slightly brown; (4) deep brown or nearly black, sharply marginated, round or oval, pinhead-sized to lentil-sized spots on the skin, so-called moles, and (5) very small pedunculated fibromas in the region of the neck.

In 1921 van der Hoeve [6] found in the eyes of seven patients suffering from tuberous sclerosis peculiar tumors in the retina. In 1927 Nitsch [7] was the first to diagnose tuberous sclerosis with the ophthalmoscope. He reported visualizing tumors in each eye of an 11 year old child, the tumor in one eye being about 4 disk diameters in size and protruding into the vitreous, extending from 2 D. nasally to 7 D. temporally. Mendez da Costa [8] presented two other cases before the Dutch Dermatologic Society, and in 1929 Herrenschwand [9] reported at length on a retinal tumor in the left eye of a 27 year old mentally normal woman; dermatologists found Pringle's [4] nodules and suspected the condition to be tuberous sclerosis. The retinal tumor began on the nasal margin of the disk, was half the size of the disk and protruded about 3 D. It was shining white and glittering and seemed to be composed of many drusen. The surface was tuberous, and the whole tumor resembled a white mulberry.

In 1932 Horniker [10] described five cases of tuberous sclerosis in which he found retinal tumors described as flat circular or oval reddish yellow areas surrounded by pigment, from which protruded tapioca-like nodules. He also noted pigmented nevi of the skin.

In 1934 A. Vogt [11] reported a case in which there was a mulberry-like tumor not much greater in diameter than the optic disk, which remained the same size during observation over a period of several years.

Other cases were reported in 1935 by Rintelen,[12] and by Gottlieb and Lavine,[13] who found in their cases unusual lesions of the bones as well as several flat tumors in each retina. In the same year H. Messinger [14] reported the case of an Italian man aged 20 years who had had typical epileptic attacks for two years. The father and paternal uncle were epileptic also. The right disk was hidden by a white glistening

6. van der Hoeve, J.: Arch. f. Ophth. **105**:880, 1921.
7. Nitsch, M.: Ztschr. f. Augenh. **62**:73, 1927.
8. Mendez da Costa: Zentralbl. f. Haut- u. Geschlechtskr. **27**:739, 1928.
9. von Herrenschwand, F.: Klin. Monatsbl. f. Augenh. **83**:732, 1929.
10. Horniker, E.: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. **49**:357, 1932.
11. Vogt, A.: Ztschr. f. Augenh. **84**:18, 1934.
12. Rintelen, F.: Ztschr. f. Augenh. **88**:15, 1935.
13. Gottlieb, J. S., and Lavine, G. R.: Tuberous Sclerosis with Unusual Lesions of the Bones, Arch. Neurol. & Psychiat. **33**:379 (Feb.) 1935.
14. Messinger, H.: Am. J. Ophth. **19**:516, 1936.

mass extending forward 5 D. Neurologic examination gave negative results. There was no mental deficiency. Multiple tumors of the skin were present in the form of small pigmented fibrous nodules on the sides of the neck. The patient died of pneumonia, and the autopsy

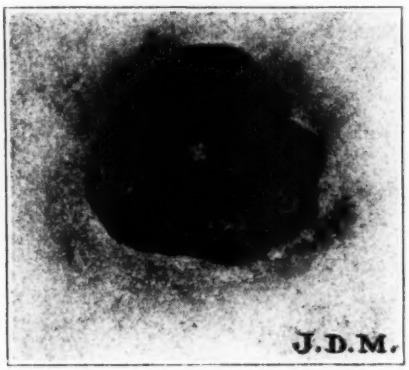


Fig. 1.—Mole, actual size. Notice the similarity to the retinal tumor.

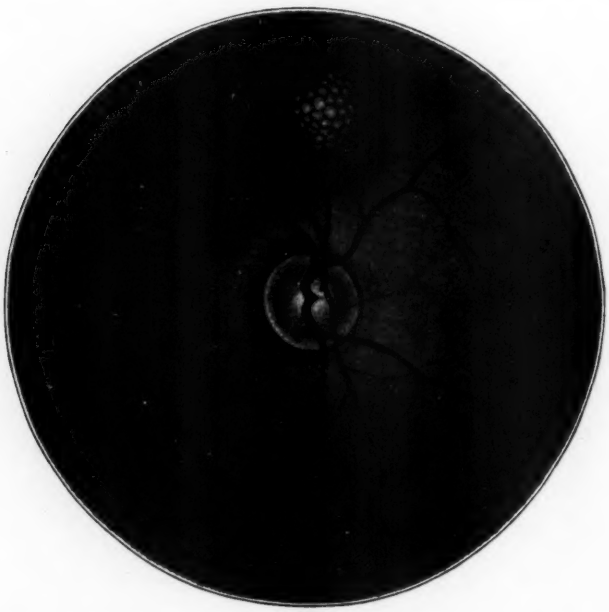


Fig. 2.—Artist's illustration of retinal tumor occurring in association with tuberous sclerosis.

showed multiple tumors in the cerebral cortex, the wall of the heart and the kidneys.

REPORT OF CASE

The patient was A. F., a white man aged 43, married and the father of six children. The family history was negative as to known epilepsy, mental disease, imbecility or cutaneous disease. The personal history was of no relative merit

until the patient enlisted in the Army during the World War. While in the Army he had several epileptic attacks and was discharged as 100 per cent disabled on account of epilepsy. He was later observed in a hospital for a period of eight weeks, where on discharge the diagnosis of his condition was changed to hysteria. The patient had no complaints except that he suffered an epileptic attack about once a month, varying from petit mal to grand mal. On examination of the patient's six children, varying in age from 3 to 16 years, no retinal tumors were found. However, two of the children were found to possess pigmented nevi.

The results of physical examination were essentially negative, except for pedunculated fibromas on the right postaxillary fold and a dark brown, circular, slightly elevated mushroom-like mole, approximately 3 cm. in diameter, on the skin on the lower left costal margin. There were several flat fibromas of the skin on the back. Roentgenograms of the chest and the skull, the Wassermann test of the spinal fluid and blood, a blood count and examination of the urine all gave negative results. Neurologic examination revealed no pathologic changes. The patient's intelligence was normal, and he did not show any mental disorder.

Examination of the eyes showed vision of the right eye to be 20/15 and that of the left eye 20/15. The visual fields were normal. The lids, conjunctiva, cornea, pupil, anterior chamber, iris, lens and vitreous of each eye were normal.

The fundus of the left eye was normal. The disk of the right eye was sharply marginated; the color was normal, and the blood vessels on the disk and on the periphery were normal. Approximately 2 disk diameters above the nerve head was a grayish white tumor approximately the size of a normal disk in diameter and elevated from 2 to 3 D. appearing to consist of small glittering drusen. The surface of the growth was tuberous, and the whole tumor looked like a white mulberry.

COMMENT

According to van der Hoeve,[15] the retinal tumor macroscopically usually has the appearance of a white mulberry; i. e., it is made up of little buds which can have very thin roots and perhaps break off and fall into the vitreous. It arises from the nerve fiber layer of the retina and may break through the holes in the membrana limitans interna. The tumor may also be found on the disk.

Microscopically, it is made up of a peculiar kind of cell, which is large, having much protoplasm and a big nucleus and nucleolus. These cells look typical of neither a glial nor a ganglion type of cell, which supports evidence that they are embryonic in character. The tumor contains spaces without a special wall, filled with serum or blood, and may show signs of inflammation but have only a few blood vessels.

That the disease is in all probability a hereditary one has been demonstrated many times, although it may manifest itself in a different and less complete way in direct descendants. Because of this fact the family history can play a great role in helping to make the diagnosis. Van der Hoeve[16] traced the disease through three genera-

15. van der Hoeve, J.: Tr. Ophth. Soc. U. Kingdom **52**:1380, 1932.
16. van der Hoeve, J.: Arch. f. Ophth. **111**:1, 1923.

tions at one time. According to Critchley and Earl,[17] the family history often shows no evidence of tuberous sclerosis but may show a strong psychopathic taint, and epilepsy and alcoholism are common. In their series of reported cases, they were able to obtain a family history in twenty, in thirteen of which there were marks of psychopathy. As the disease may manifest itself in different forms and incompletely in different members of the same family, Critchley and Earl [17] in their extensive monograph on the subject suggested that one is justified in recording the following types as probably representing incomplete forms of tuberous sclerosis: (1) adenoma sebaceum alone; (2) adenoma sebaceum associated with epilepsy but with no mental change; (3) adenoma sebaceum associated with symptoms of cerebral tumor, and (4) visceral tumor alone, including retinal tumor.

The fact that after the diagnosis had been made in the case just reported one other patient, who will be reported on elsewhere, came to autopsy, and two other patients seen by us had a condition that seemed to be tuberous sclerosis of the brain, it appears to us that this is a far more frequent disease than the few reports in the ophthalmologic literature would lead one to expect. If the symptomatology of this disease and its formes frustes become generally known, the diagnosis will be made more often and many cases of grand mal or petit mal made clear.

SUMMARY

A case of tuberous sclerosis of the brain with retinal tumor is reported. Nitsch [7] in 1927 was the first to diagnose this disease with the use of the ophthalmoscope, although previously retinal tumors had frequently been found in known cases of tuberous sclerosis. This condition is a heredofamilial disease associated with mental deficiency, manifested by cerebral symptoms varying in degree from "absences" to petit mal and grand mal. Other manifestations are Pringle's [4] nodules of the face or other fibromas of the skin distributed elsewhere on the body, principally the neck, and fibromas of the heart, kidneys, spleen, lungs and brain, as well as tumors of the retina or the disk. The retinal tumors arise from the nerve fiber layer and protrude into the vitreous and have the appearance of a white mulberry or tapioca-like nodules. Not all patients present complete manifestations. There are many incomplete forms—a factor supporting the opinion that the disease is not very rare and probably less often recognized than it actually occurs.

17. Critchley, M., and Earl, C. J. C.: Brain **55**:311, 1932.

ADENOMATOUS HYPERPLASIA OF THE EPITHELIUM OF THE CILIARY BODY

REPORT OF A CASE

JOHN E. L. KEYES, M.D.
AND
PAUL G. MOORE, M.D.
CLEVELAND

A case of hyperplasia of the ciliary epithelium is reported because of several unusual circumstances present. The tumor was unusually large. Its presence was noted before removal of the eye. Except for the presence of cataract, the eye was not diseased. At the time of enucleation of the eye the patient was under 30 years of age. Histologically and clinically this tumor has proved to be benign.

REPORT OF CASE

F. K., a married white woman aged 29 years, was first seen on April 2, 1935. The patient complained of gradual diminution of vision in the left eye over a period of at least one year. She associated the impairment of vision in the left eye with a blow on the skull over the right parietal region. The previous ocular history was negative. The patient's medical history and physical examination did not reveal anything pertaining to her ocular condition. Uncorrected vision in the right eye was 6/4. The right eye was normal. In the left eye, vision was reduced to perception of light at 20 feet (6 meters). Vision was unimproved by glasses. The tension in the left eye was 18 mm. of mercury (Schiötz). The cornea of the left eye was clear. A dense general opacity of the crystalline lens prevented examination of the fundus. The anterior chamber was shallow. In the region of 6 o'clock, toward the angle of the anterior chamber, a peripheral portion of iris was in contact with the posterior surface of the cornea. In this region the brown iris was more deeply pigmented. Through the pupil a mass of brown pigment was seen, between the iris and a cataractous lens. The pupil was moderately dilated after the instillation of homatropine. The brown pigment seen at the pupillary margin of the iris in the region of 6 o'clock was now revealed to be part of a dense brown mass. This mass extended backward toward the ciliary body. The mass was also in contact with the equator of the lens and the posterior surface of the iris. The lower portion of the lens appeared to be tilted slightly backward. A peripheral portion of the iris was pressed against the cornea. The general opacity of the lens was more dense in the immediate neighborhood of the tumor. In the region of the tumor there was some absorption of transmitted light. A tentative diagnosis of sarcoma of the iris and ciliary body was made. The amount of pigment visible through the pupil increased.

From the Institute of Pathology and the Department of Ophthalmology, Western Reserve University.

Vision was reduced to counting fingers at 3 feet (90 cm.). On May 11 the left eye was enucleated. Two years later there was no sign of local extension or general metastasis.

REPORT OF PATHOLOGIC EXAMINATION

The section containing the largest amount of tumor (fig. 1) had its longer axis parallel to the sclera and cornea. This measured 4.5 mm. The tumor projected posteriorly to a depth of 3.6 mm. The mass was well defined in all its margins.

The nodule was circumscribed but not encapsulated and occupied the entire thickness of the corona ciliaris (pars plicata) of the ciliary body, with encroachment on the adjacent iris. The posterior third or more of the iris had been replaced by expansion of the hyperplastic mass. This portion of the iris was in

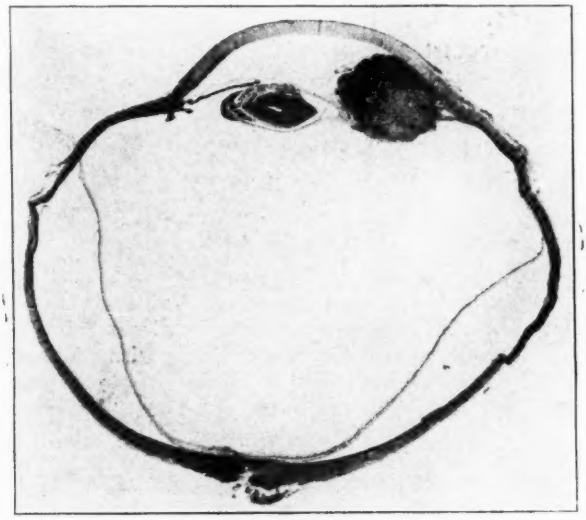


Fig. 1.—Section of the eye, showing location of the tumor.

contact with the posterior surface of the cornea. The canal of Schlemm and the meshwork of the angle of the anterior chamber were filled by pigment and pigment-bearing atypical cells. Descemet's membrane was uninterrupted, but in the region of the tumor the corneal endothelium had largely disappeared. At the junction of the iris and the cornea, the corneal endothelium was reflected onto the anterior surface of the iris.

The tumor was in contact with and adherent to the equator of the crystalline lens. The crystalline lens was cataractous. A small pigment-covered nodule presented in the anterior chamber between the pupillary margin of the iris and the crystalline lens. The portion of the lens in proximity with the tumor exhibited subcapsular hyperplasia of lenticular fibers. These fibers were dense and hyalinized. Immediately beneath the capsule of the lens, in the region of the tumor, there was a small, narrow, irregular area of basophilic material resembling bone, calcified but not containing bone cells. At one point the capsule of the lens was interrupted, and pigment-bearing cells were present inside the lens.

The nodule was comprised in part of closely disposed cords of cylindric epithelial cells enclosed by moderately heavy collagenous basement membranes, the cells being arranged in rows, forming solid strands or alveoli, or lining structures resembling tubules but without definite lumens. The base of each cell rested on the enclosing basement membrane, and except for the basement membrane there was practically no stroma. The cells had an abundant amount of pale acidophilic cytoplasm, which was homogeneous at the basal, and granular at the distal, poles of the cells. At the periphery of the nodule many of the cells contained fine and coarse granules of dense brown pigment. The cells containing pigment were more pleomorphic than those that were nonpigmented. Some masses of cells showed uniform pigmentation, and in some instances the entire cellular mass had disintegrated, leaving a circumscribed conglomeration of free pigment within an intact basement membrane. In a few instances alveoli were

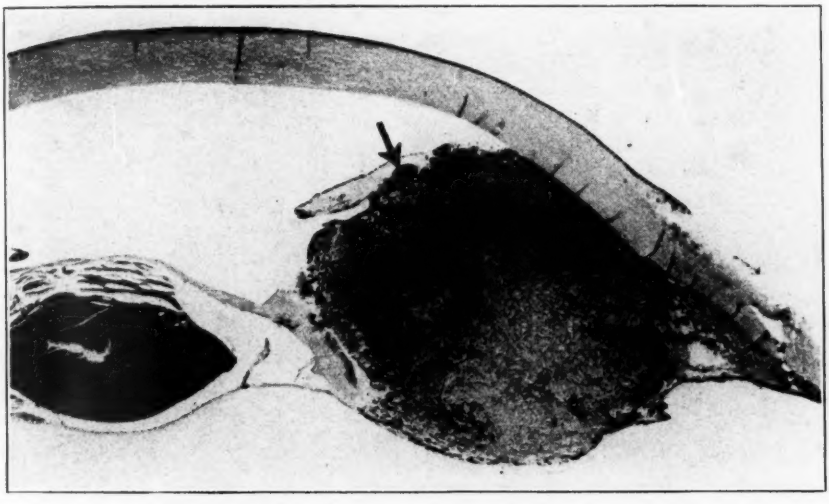


Fig. 2.—A higher magnification of a portion of figure 1. The distribution of pigment in the tumor is shown. The nodule has replaced the corona ciliaris and the posterior portion of the iris. It is adherent to the cornea and the crystalline lens. The canal of Schlemm is represented by a dark streak. The space in the ciliary body is an artefact. × about 11.

composed of both pigmented and nonpigmented cells, but there was no reproduction of the normal arrangement of ciliary epithelium, in which the basal cell layer is pigmented and the superficial cell layer is nonpigmented. There was no sign of secretory activity. There was no obvious continuity between the strands of cells and the cells covering the surface of the ciliary body. The nuclei were uniformly round, and the chromatin was homogeneously distributed. A basal nuclear polarity was maintained uniformly throughout the cylindric cells of the tumor, and no mitoses were observed. Although there was no capsule, yet the adjacent structures appeared to be displaced and attenuated, rather than invaded, so that the nodule appeared to have expanded by centripetal rather than centrifugal growth.

Few of the tumor cells were entirely free from pigment. The posterior and the central portion of the tumor were relatively free from pigment. The anterior portion of the tumor was deeply pigmented. In the anterior portion of the tumor, particularly near the iris, clusters of approximately a dozen smaller cells with small dense nuclei and deeply stained cytoplasm were seen. These cells suggested immature forms of the larger cells constituting the main mass. In this region the supporting tissue was almost acellular and was in part delicately fibrillar and in part hyalinized. Vascularization by small vessels about the size of capillaries was scanty. In the region of the ciliary body and of the iris the blood supply was best.

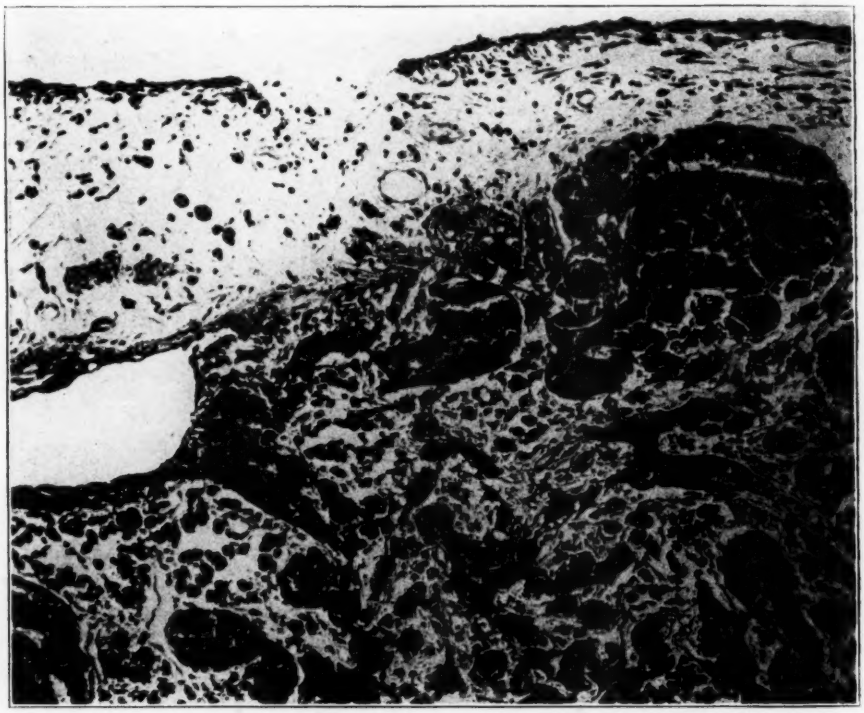


Fig. 3.—A higher magnification of a portion of figure 2, indicated by the arrow. This section demonstrates the relationship between the margin of the tumor and the iris. × 135.

Aside from the presence of the tumor and the cataractous lens, the eye was normal. In the immediate neighborhood of the mass, in the anterior portion of the ciliary body, a blood vessel with a very moderate perivascular accumulation of lymphocytes was noted. In the immediate region of the tumor the blood vessels of the iris showed mild proliferation of the media. In the region of the crystalline lens a degenerative change was apparent. A distinct tendency to hyalinization of adjacent tissues was evident. Except in the region of the growth, the filtration angle of the anterior chamber was patent. In the immediate neighborhood of the tumor the pectinate ligament was very dense and hyalinized. The meshwork of the filtration angle of the anterior chamber, the pectinate ligament, and Schlemm's

canal contained many pigmented and nonpigmented cells. No iron-containing pigment was observed in the tumor. In the iris, adjacent to the tumor, there was proliferation of the "myoglial" cells of the dilator muscle. These cells did not seem to be present in the tumor. The pigment layer of the posterior surface of the iris was reflected on the anterior surface of the tumor. At the anterior edge of the tumor, as it replaced or invaded the iris, it was difficult to identify

Fig. 4.—A section showing the relationship between the tumor and the crystalline lens. The capsule of the lens is divided. Tumor cells occupy an opening in the outer portion of the divided capsule of the lens. Beneath the capsule is some basophilic material resembling bone. × 135.

the tissue of the iris for any distance within the tumor. A few isolated blood vessels and, possibly, a few connective tissue cells could be seen. The appearance presented was one of replacement rather than invasion of the iris. The fibers of the zonule of Zinn ran across and lay on the inner surface of the tumor. Pigment-

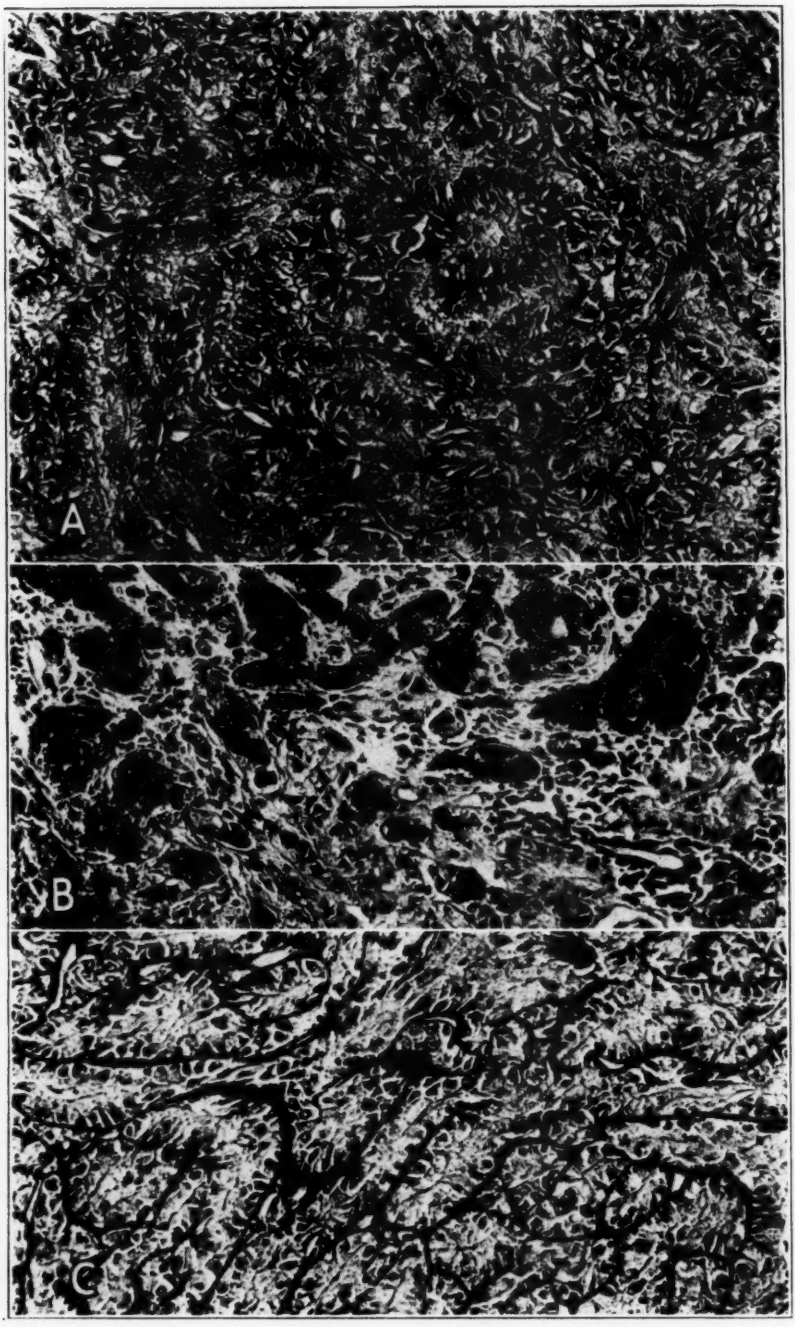


Fig. 5.—*A*, small section fror. the center of the tumor; hematoxylin and eosin stain; × 165. *B*, section showing the transition from the lightly pigmented to the more heavily pigmented portion of the growth; hematoxylin and eosin stain; × 165. *C*, section of the tumor stained with azocarmine to demonstrate the basement membranes of the cells; × 165.

bearing cells and a few blood vessels were observed among the fibers of the zonule. There were a few pigment-bearing cells in the anterior portion of the vitreous.

The neoplastic character of the mass was indicated solely by the fact that it constituted a nodule of abnormal architecture. It is possible that cellular hyperplasias alone in a situation such as the ciliary body might be present in nodular form. There was no clear indication that this tumor was invasive, and there was no other indication that furnished conclusive evidence of malignancy.

COMMENT

The term "adenomatous" is used to portray the histologic appearance of the tumor, which was that of an adenoma simplex (or solidum) except for the absence of a capsule. The tumor was therefore, strictly speaking, not a true adenoma. It was a nodular hyperplasia of the ciliary epithelium. The cells of the tumor may have a threefold origin: They may arise partly from the pigment layer of the ciliary epithelium, partly from the pigment epithelium of the iris and partly from the nonpigmented epithelium of the ciliary processes. In a normal eye the nonpigmented epithelium of the ciliary processes near the origin of the iris gradually becomes pigmented. This is particularly noticeable on the anterior side of the most anterior of the ciliary processes. Here the internal layer of epithelium abruptly becomes pigmented and passes onto the posterior surface of the iris as a heavily pigmented epithelial layer. In the same position the pigment-bearing epithelial layer of the ciliary processes becomes less pigmented, and at the beginning of the iris this layer of pigment epithelium is replaced by "myoglia," the slightly pigmented cells which constitute the dilator muscle of the iris. It is possible that the nonpigmented epithelium in the anterior portion of the ciliary processes, if hyperplastic, might become pigmented. It is also possible that proliferating pigmented ciliary epithelium might be relatively devoid of pigment.

The etiology of the tumor is obscure. The new growth is possibly an earlier and more extensive form of the small benign epithelial tumor of the ciliary body of Fuchs,[1] first reported by him in 1883, and since found in various forms by several investigators.[2] The majority of the tumors of the ciliary epithelium reported have been observed accidentally at autopsy or in eyes removed for causes other than the tumor. With a few exceptions, the tumor was present only in the eyes of persons over 50 years of age.

1. Fuchs, E.: Prolapsus Chorioideae, Arch. f. Ophth. **29**:4, 1883.

2. Ginsberg, S.: Vom Ziliarepithel ausgehende Tumoren, in Henke, F., and Lubarsch, O.: Handbuch der speziellen pathologischen Anatomie und Histologie, Berlin, Julius Springer, 1928, vol. 11, pt. 1, p. 551.

A few cases of tumor of the ciliary epithelium have been reported in young persons previous to removal of an eye, notably, by R. A. Greeves [3] in a 10 year old girl, by M. L. Hine [4] in a soldier aged 28 years, by V. Petragnani [5] in a specimen removed for biopsy from the eye of a woman aged 30 years and by W. Zentmayer [6] in the left eye of a woman aged 56 years. Greeves and Hine considered the tumor in their cases a malignant growth of epithelial origin. Petragnani, and Verhoeff, in studying Zentmayer's specimen microscopically, failed to see any evidence of malignancy.

Clinically, these cases resembled the one reported. The pathologic picture, with the exception of the tumor in the case reported by Hine, was also similar. In discussing Hine's case, Treacher Collins expressed the opinion that the growth was an example of the condition encountered by Greeves. Opacities were present in the crystalline lens in all four instances.

SUMMARY

A case of nodular hyperplasia of the epithelium of the ciliary body of the left eye in an otherwise healthy white woman 29 years of age is reported. The presence of the tumor was noted before removal of the eye. The eye was normal except for the ciliary nodule and a cataract. Hyperplastic ciliary epithelium had formed a large nodule which had replaced the corona ciliaris and the posterior third of the iris. The periphery and the anterior portion of the nodule were heavily pigmented. The central portion of the growth was relatively free from pigment. Two years after removal of the left eye the remaining eye was normal and the patient healthy.

---

3. Greeves, R. A.: A Rare Case of Primary Malignant Growth of the Ciliary Body, Tr. Ophth. Soc. U. Kingdom **31**:261, 1911.

4. Hine, M. L.: Primary Epithelioma of the Ciliary Body, Tr. Ophth. Soc. U. Kingdom **40**:146, 1920.

5. Petragnani, Vittorio: Rara neoformazione benigna del corpo ciliare, Boll. d'ocul. **14**:1693, 1935.

6. Zentmayer, William: A Case of Hyperplasia of the Epithelium of the Ciliary Processes (Ciliary Adenoma of E. Treacher Collins), Arch. Ophth. **16**:677 (Oct.) 1936.

VITAMIN D AND MYOPIA

JOSEPH LAVAL, M.D.
NEW YORK

Many theories have been advanced for the etiology of myopia. Some (Arlt, Branner and Heinonen) believe that continued use of the eyes for close work, such as reading and sewing, causes elongation of the globe as a result of compression by the internal rectus muscle. Others believe that the general physical condition of city dwellers is inducive to the development of myopia (Steiger). Some insist that the intra-ocular tension is increased by prolonged near work, with resultant stretching of the posterior pole of the eye, and this accounts for the prescribing of miotics by some ophthalmologists in cases of myopia (Mayer). Levinsohn is the chief protagonist of the view that by persistently keeping the head bent downward in reading and sewing the eyeball is made to stretch in its antero-posterior diameter, the posterior pole bearing the brunt.

These views really belong in the category of mechanical influence causing stretching of the eye. Opposed to this is the belief as expressed by Vogt, for example, that the myopic changes in the fundus occur in patients who are biologically and by heredity predisposed to these degenerative stigmas, which are of the same nature as senile changes occurring in the region of the posterior pole. In other words, there is extremely early development of senile changes in the eyes of certain young persons which causes myopia. Couadau decided that heredity plays a part in transmitting the feebler resistance of the sclera, and this is also the opinion of Tscherning and Comberg.

Luedde claimed that by dissociation of the two eyes in near vision through monocular cycloplegia, consistently excellent effects were obtained over a period of eight years for myopic patients. He based his work on Jackson's statement that "excessive convergence in the great majority of cases starts the myopia and keeps it progressive" and also on Donder's explanation of the exemption from myopia of watchmakers who use a monocular loupe. Luedde also feels that "a sclera with less than average resistance yields to the increased intra-ocular pressure incident to extra-ocular muscular action in sustained and excessive convergence."

The stroma of the sclera and cornea consists mainly of fibrous tissue. Some elastic tissue is also present, of negligible amount in the

sclera, but a moderate number of elastic fibers are present in the cornea. As regards the amount of calcium in the cornea and sclera, no chemical determinations have been made. According to a personal communication received from Steenbock in 1931, no chemical determination of the amount of calcium in the cornea or the sclera of any animals on a diet deficient in vitamin D had been made up to that time. To my knowledge, none has been made since that date. In 1934, acting on a suggestion from me that I had been experimenting clinically with the use of viosterol (vitamin D) in early cases of myopia and keratoconus, Blackberg and Knapp published the results of their findings in the eyes of young dogs which had been on a diet deficient in vitamin D and calcium. Their studies included clinical and microscopic examinations, which showed "prominence of the eyeball, widening of the palpebral fissure, episcleral injection, primary ectasia of the cornea, deepening of the anterior chamber, and swollen, muddy iris." Microscopically there were irregularity and edema of the stroma of the cornea, and edema of the fibrous tissue of the sclera, resulting in swelling. However, it is still not known whether the amount of calcium in the cornea and sclera was changed as a result of the vitamin D and calcium dietary deficiency.

As regards the role of vitamin D and calcium metabolism in the development of myopia, it is common knowledge that at times during pregnancy the amount of myopia increases. Furthermore, the utilization of the mother's calcium for the development of the fetus sometimes causes a depletion of the calcium reserve of the pregnant woman, and changes in the teeth may occur. Macy has shown that a large intake of vitamin D during pregnancy is of importance to the mother. A clinical entity which emphasizes the connection between the sclera and the bones, and thus possibly the importance of calcium metabolism for the sclera, is the syndrome of blue scleras and brittle bones, in which condition deafness and marked relaxation of the ligaments are often present (Hills and McLanahan). To complete the picture it would be necessary only to report that patients with blue scleras are all myopes, owing to the thinning and stretching of the sclera. However, it must be remembered that the blueness and thinning take place in the anterior segment of the globe, in the region of the ciliary body, and that the stretching, if any, would be in the transverse, and not in the anteroposterior, diameter. This suggests that some of these patients might have subluxated lenses due to pulling and possibly tearing of the zonular fibers. However, I have not been able to find any cases of such a condition reported, nor have I seen any subluxation in the eyes with blue scleras that I have examined. I am reminded particularly of one Negro child 6 years old whose scleras in the anterior segments were

so blue that it seemed that methylene blue must have been splashed over them. This child had normal lenses in normal position and was not myopic.

These facts—(1) the changes in the teeth of pregnant women plus occasional increase in myopia; (2) the association of thin, blue scleras with brittle bones; (3) the development of myopia most often during adolescence, when there is an increased rate of growth, with subsequent increased demand on the tissues, and (4) the microscopic changes which occur in the fibrous tunic of the eye when there is depletion of vitamin D—all suggest the clinical use of vitamin D to arrest the development of myopia.

In March 1933 I wrote to the chief editor of the ARCHIVES to the effect that since 1930 I had been using vitamin D and calcium in cases of myopia and keratoconus, with what I then considered most encouraging results. This communication was prompted by reading an abstract of Walker's article in the *British Journal of Ophthalmology,* in which he stated that he believed that progressive myopia was due to inherent weakness of the sclera. Some of his patients also had dental caries due to calcium deficiency. He wrote that he had been prescribing calcium for three years, with "suggestive and promising results," and also mentioned that D. J. Wood had suggested using calcium together with parathyroid extract.

Since the relation of vitamin D to the prevention of rickets has been definitely established, this vitamin, together with calcium, has been prescribed not only for rickets but in other bone conditions in which calcium metabolism has been impaired. It is also being used in dentistry in the hope (sic) that it will prevent the formation of cavities in the young. And it also is prescribed in those cases in which one wishes to increase the absorption and utilization of calcium. The most common form in which it is used is drops of viosterol. Often it is given in combination with vitamin A as cod liver oil with viosterol or as halibut liver (haliver) oil with viosterol. The latter (haliver oil) is usually given in concentrated form in small perles. Cod liver oil is given in its natural form, unconcentrated, with viosterol added to it.

According to the Council on Dental Therapeutics of the American Dental Association, "cod liver oil has a favorable influence on the absorption and subsequent deposition of calcium and phosphorus in the bones and in the teeth." The council concluded that "empirical prophylaxis by regulation of the diet of the children is distinctly effective in combating caries and, at least until the problem becomes more fully understood, deserves more universal adoption." Furthermore, they also decided that "there is no carefully controlled evidence that the addition of calcium and phosphorus compounds, whether inorganic or organic,

promote retention of these elements . . . except in known cases of deficiency. Where this occurs, milk serves as an excellent source of calcium and phosphorus in a readily assimilable form."

CLINICAL EXPERIMENTS

I have been using 10 drops of viosterol daily as the source of vitamin D plus a quart of milk daily as the source of calcium for all patients with myopia up to the age of 17 years. At one time I used vitamin D milk, but the amount of vitamin D in a quart of milk is variable, as *The Journal of the American Medical Association* has often pointed out. Of course, the younger the patient when he presents himself for treatment the better one can judge the merits of this therapeutic method. Some patients have refused viosterol because of its oily character, and for these patients I have ordered one perle of concentrated haliver oil with viosterol. It is true that vitamin A is added when the perles are used, but this makes no difference in evaluating the usefulness of vitamin D for myopic patients. I have not used this form of therapy for clinic patients but have confined its use to private patients only, because, first, the cost of the drops of viosterol is something to be considered and, second, private patients are controlled more easily and will cooperate more readily than clinic patients.

During the past six years there have been eighty-six myopic patients whom I have considered young enough for a trial with vitamin D and milk. Of these, twenty were seen during 1936, and these will not be included in this report, as the interval of treatment was too short. Of the remaining sixty-six, eighteen have not returned or have not taken the viosterol continuously enough to warrant inclusion in this study. That leaves forty-eight patients who have taken vitamin D and milk continuously and have been seen at nine month intervals for from three to six years.

Of these forty-eight patients, there were twelve between the ages of 5 and 10 years, twenty-five between the ages of 10 and 14 years and eleven between the ages of 14 and 17 years, when first seen. In stating the total amount of the myopia, the spherical and cylindric powers will be added together, so that a —0.50 D. sphere together with a —1.00 D. cylinder will be considered as indicating 1.50 D. of total myopia. Among the twelve patients between the ages of 5 and 10 years, the amount of myopia present when the patient was first seen varied between 0.50 and 2.00 D. In every one of these patients during the three to six years that they have been under observation with a daily intake of viosterol and milk there has been an increase in the amount of the myopia. In some the increase has been only 1.00 D.; in others it has been as much as 2.50 D., but not one patient has had

a decrease in the amount of the myopia or even an arrest of the progress. Among the twenty-five patients between the ages of 10 and 14 years, the myopia when the patient was first seen varied between 0.50 and 3.00 D. In these, also, there has been an increase in the myopia, ranging from 0.50 to 2.50 D., but in not one of them has the total myopia increased to above 6 D. The eleven patients of the last group, those between 14 and 17 years of age, had a total myopia of from 1.00 to 4.00 D. when first seen. In these the increase has been the least—from 0.50 to 2.00 D.—but again there were no instances of diminution and no complete arrest before the age of 20.

I wish to cite one case in full as fairly descriptive of all the others.

S. B., was first seen in April 1930 at the age of 13 years, at which time her right eye had normal vision with a —2.25 D. sph. ⌒ —1.50 D. cyl., ax. 15, and the left eye had normal vision with a —0.25 D. sph. ⌒ —0.50 D. cyl., ax. 165.

Summary of Myopic Progress of Patient

Date	Correction for Right Eye		Correction for Left Eye		
	Sph., D.	Cyl., D.	Sph., D.	Cyl., D.	
April 1930	—2.25 ⌒	—1.50	—0.25 ⌒	—0.50	Viosterol given
December 1930	—2.50 ⌒	—1.50	—1.00 ⌒	—0.50	
August 1932	—2.50 ⌒	—1.50	—1.50 ⌒	—0.50	
May 1933	—2.75 ⌒	—1.50	—1.75 ⌒	—0.50	
January 1934	—3.00 ⌒	—1.50	—2.00 ⌒	—0.50	
December 1934	—3.00 ⌒	—2.00	—2.25 ⌒	—1.00	Viosterol discontinued
March 1936	—3.25 ⌒	—2.00	—2.25 ⌒	—1.00	
February 1937	—3.25 ⌒	—2.00	—2.25 ⌒	—1.00	

She was put on viosterol and milk. The table gives a summary of her myopic progress.

The patient is now 20 years old; the viosterol and milk were discontinued in 1934, at the age of 17. The total myopia of the right eye at the age of 13 years was —3.75 D., and that of the left eye was —0.75 D. Four years later, at the age of 17, the total myopia for the right eye was —5.00 D., and that of the left eye was —3.25 D. Three years later, at the age of 20, the total myopia of the right eye was —5.25 D., and that of the left eye was —3.25 D. During the four years that the viosterol and milk were taken, between the ages of 13 and 17 years, the myopia of the right eye increased by 1.25 D., and the myopia of the left eye increased by 2.50 D. During the next three years, between the ages of 17 and 20, during which time no viosterol was taken, the myopia of the right eye increased by 0.25 D., and that of the left eye was stationary.

The case just cited certainly yields no startling data, since many patients without any treatment and often without wearing glasses constantly have no greater increase in the total myopia than the patient here described. This is the usual progress in cases of myopia: The amount of myopia increases during adolescence up to about the age of 17 or 18 years, and after that it is usually stationary. All the patients

not only took viosterol and milk daily but also wore the glasses constantly. Furthermore, they were instructed to do as little reading as possible; their posture while reading was corrected, and the lighting was checked. All these hygienic measures were of no avail in arresting the progress of the myopia.

CONCLUSIONS

Again I must admit disappointment in the use of vitamins for certain ocular disorders, recalling that in retinitis pigmentosa I (Levine) had no success with the use of vitamin A. Accordingly, I must disagree with those who say that treatment with vitamin D and calcium helps patients who have myopia by reducing the amount of the myopia, keeping it stationary or preventing as rapid an increase as is usually found in patients who have not used this form of therapy.

BIBLIOGRAPHY

Arlt, C. F.: Ueber die Ursachen und die Entstehung der Kurzsichtigkeit, Vienna, Wilhelm Braumüller, 1876.

Blackberg, S. N., and Knapp, A. A.: Ocular Changes Accompanying Disturbances of Phosphorus-Calcium Metabolism, Arch. Ophth. **11**:665 (April) 1934.

The Influence of Vitamin D—Calcium-Phosphorus Complex in the Production of Ocular Pathology, Am. J. Ophth. **20**:405 (April) 1937.

Branner, J.: Ueber die degenerativen Stigmata hochgradig Myoper, Klin. Monatsbl. f. Augenh. **90**:527 (April) 1933.

Calcium Therapy in Dentistry, editorial, J. A. M. A. **108**:1655 (May 8) 1937.

Comberg, W.: Anatomische und experimentelle Untersuchungen über die mechanischen Faktoren der Myopiegenese, Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch. (1928) **47**:126, 1929.

Couadau, A.: La myopie monolatérale, Paris, J. B. Baillière et fils, 1929, p. 119.

Donders, F. C.: Die Anomalien der Refraktion und Akkommodation des Auges: Zweiter Abdruck der unter Mitwirkung des Verfassers von Prof. Dr. Becker herausgegebenen deutschen Originalausgabe, Vienna, Wilhelm Braumüller, 1888, p. 350.

Heinonen, O.: Etiology of School and Occupation Myopia, Acta ophth. **6**:238, 1928.

Hills, R. G., and McLanahan, S.: Brittle Bones and Blue Scleras in Five Generations, Arch. Int. Med. **59**:41 (Jan.) 1937.

Jackson, Edward: Norms of Refraction, Tr. Sect. Ophth., A. M. A., 1931, p. 174.

Levine, Joseph: Is Retinitis Pigmentosa Due to Vitamin Deficiency? Arch. Ophth. **9**:453 (March) 1933.

Progressive Myopia, ibid. **9**:459 (March) 1933.

Levinsohn, G.: Die Entstehung der Kurzsichtigkeit, Berlin, S. Karger, 1912.

Luedde, W. H.: Monocular Cycloplegia for the Control of Myopia, Am. J. Ophth. **15**:603 (July) 1932.

Macy, I. G.; Hunscher, H. A.; McCosh, S. S., and Nims, B.: Metabolism of Women During Reproductive Cycle: Calcium, Phosphorus, and Nitrogen Utilization in Lactation Before and After Supplementing Usual Home Diets with Cod Liver Oil and Yeast, J. Biol. Chem. **86**:59 (March) 1930.

Mayer, Leo L.: Epinephrine in Progressive Myopia, Am. J. Ophth. **14**:908 (Sept.): 1015 (Oct.) 1931; **15**:35 (Jan.) 1932.

Steiger, A.: Die Entstehung der sphärischen Refraktionen des menschlichen Auges, Berlin, S. Karger, 1913.

Tscherning: Studien über die Aetiologie der Myopie, Arch. f. Ophth. (pt. 1) **29**:201, 1883.

Vogt, A.: Parallel Between Senile and Myopic Degeneration of Eyeball, Schweiz. med. Wchnschr. **54**:429 (May) 1924.

Ueber Berührungspunkte der senilen und der myopischen Bulbus Degeneration, Klin. Monatsbl. f. Augenh. **72**:212, 1924.

Walker, J. P. S.: Progressive Myopia: A Suggestion Explaining Its Causation and for Its Treatment, Brit. J. Ophth. **16**:485 (Aug.) 1932.

Wood, D. J.: Calcium Deficiency in Blood with Reference to Spring Catarrh and Malignant Myopia, Brit. J. Ophth. **11**:224 (May) 1927.

POWER AND MAGNIFICATION PROPERTIES OF CONTACT LENSES

PAUL BOEDER, PH.D.
SOUTHBRIDGE, MASS.

A number of recent publications on contact lenses [1] seem to indicate that the interest in this fascinating subject is growing.

While particular attention is naturally given to the clinical aspect of contact lenses, especially to methods of fitting them, their optical properties [2] are not always fully understood. It may not be in vain, therefore, to explain here in detail some important optical facts concerning contact lenses.

Since the understanding may be aided by considering the qualities of contact lenses in close analogy to the well known optical properties of spectacle glasses, a brief review of the fundamentals of ordinary ophthalmic lenses is offered for preliminary consideration.

In connection with an optical system two major questions are of concern: (*a*) Where is the image of a given object? (*b*) What is its magnification?

For a single spherical refracting surface, for instance, the front surface of a spherical cornea, the first question is answered by means of the fundamental equation

$$\frac{n'}{v} - \frac{n}{u} = \frac{n' - n}{r}. \qquad (1)$$

In this formula u denotes the distance of the object; v, the distance of the image, and r, the radius of the refracting surface. All distances are measured from the vertex of the surface, the direction from left to right (the direction of light rays) being considered positive. The letters n and n′ denote the indexes of refraction of the media separated by the refracting surface, n being that to the left, and n′ that to the right, of the surface.

From the American Optical Company.

Read before the New England Ophthalmological Society, Nov. 16, 1937.

1. Bruce, G. M.: Contact Glasses, Am. J. Ophth. **20**:605, 1937. Obrig, T. E.: Fitting of Contact Lenses for Persons with Ametropia; Evolution and Modern Technic, Arch. Ophth. **17**:1089 (June) 1937. For additional literature on contact glasses see these two articles.

2. Hartinger, H.: Zur optischen Theorie der Haftgläser, Ztschr. f. ophth. Optik **18**:135-161, 1930.

The expression $\frac{n' - n}{r}$ is called the surface power; it may be denoted by D_s.

The (linear) magnification, m, which is defined as the ratio $\frac{I}{O}$ (the size of the image, I, divided by the size of the object, O), is for a single spherical refracting surface given by

$$m = \frac{nv}{n'u}. \tag{2}$$

When these formulas are applied successively to the surface powers D_1 (front surface) and D_2 (back surface) of a single lens of center thickness t and a glass index of refraction n, the result is

$$v = \frac{Cu + D}{Au + B} \tag{3}$$

and

$$m = \frac{1}{Au + B}, \tag{4}$$

where the letters A, B, C and D are defined by the following relations:

$$A = D_1 + D_2 - dD_1D_2$$
$$B = 1 - dD_2$$
$$C = 1 - dD_1$$
$$D = -d = -\frac{t}{n}.$$

The distance of the object, u, is measured from the vertex of the front surface, and the distance of the image, v, is measured from the vertex of the back surface.

The most important case arises when the object is so far removed that u may be considered "infinite." Then, according to formula 3,

$$v = \frac{C}{A} = \frac{1 - dD_1}{D_1 + D_2 - dD_1D_2} \qquad u \to \infty.$$

This expression is called the back focal length of the lens. It is the distance from the back vertex to the so-called second principal focus of the lens. The reciprocal of the back focal length, namely,

$$\frac{A}{C} = \frac{D_1 + D_2 - dD_1D_2}{1 - dD_1} = \frac{D_1}{1 - dD_1} + D_2 = D_e \tag{5}$$

is called the vertex or effective power of the lens, denoted here by D_e.

When u becomes infinite, the magnification, m, tends to zero unless the size of the object, O, also becomes infinite. In this event, in which the object may subtend an angle, w, at the lens, the size of the corresponding image is given by

$$I = \frac{w}{A} = wf'. \tag{6}$$

The magnitude, which is symbolized by $A = D_1 + D_2 - dD_1D_2$, is called the equivalent focal power, and its reciprocal, f', is called the equivalent focal length. It is measured from the second principal point

of the lens to the principal focus. The second principal point is located at a distance

$$(7) \qquad \frac{C-1}{A} = \frac{-dD_1}{D_1 + D_2 - dD_1D_2}$$

from the back vertex of the lens.

If two systems of equivalent focal powers, A and A_o, are given, the equivalent focal power, A′, of the combined (centered) system is expressed by the formula

$$(8) \qquad A' = A + A_o - tAA_o,$$

where t is the distance from the second principal point of the system A to the first principal point of the system A_o. This formula is of special importance in ophthalmic optics, because the spectacle lens and the eye form a combination of two optical systems.

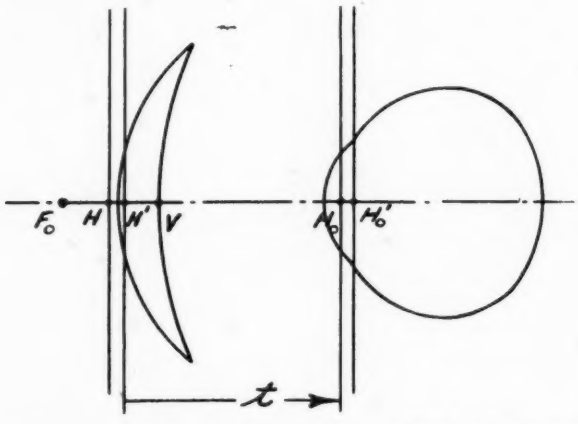


Fig. 1.—Diagram illustrating the formula $t = H'H_o = H'V + VF_o + F_oH_o$, where V represents the back vertex of the lens, F_o the anterior focus of the eye and H_o the first principal point of the eye.

According to formula 6, the size of the retinal image which an emmetropic eye of equivalent focal power, A_o, produces of a far distant object subtending an angle, w, is

$$I_e = \frac{w}{A_o}.$$

An axially ametropic eye wearing a corrective glass of effective power, D_e, at a distance h mm. in front of the cornea produces a retinal image of the same object of

$$I_a = \frac{w}{A'},$$

where A′ is defined by formula 8.

A comparison between these retinal images gives

$$\frac{I_a}{I_e} = \frac{A_o}{A'}.$$

In order to gain a clearer conception of this ratio, A′ is transformed in the following way (illustrated in fig. 1):

The quantity t in

$$A' = A + A_o - tAA_o$$

may be written

$$t = H'H_o = H'V + VF_o + F_oH_o.$$

In this expression V represents the back vertex of the lens; F_o, the anterior focus of the eye, and H_o, the first principal point of the eye. According to formula 7, $H'V = -\frac{C-1}{A}$; $F_oH_o = -f_o = f_o' = \frac{1}{A_o}$, and F_oV, the distance from the anterior focal point of the eye to the back vertex of the corrective lens, may be designated by z. Then

$$\begin{aligned} A' &= A + A_o - (-\tfrac{C-1}{A} - z + \tfrac{1}{A_o})AA_o \\ &= A + A_o + CA_o - A_o + zAA_o - A \\ &= CA_o + zAA_o. \end{aligned}$$

Since, according to formula 5, $A = CD_e$, the last expression may be written

$$A' = CA_o + zCD_eA_o = CA_o\,(1 + zD_e),$$

and the ratio $\frac{I_a}{I_e} = \frac{A_o}{A'}$, which may be called the magnification of the retinal image of the corrected axially ametropic eye as compared to the retinal image of an emmetropic eye, becomes

$$(9) \qquad \frac{I_a}{I_e} = \frac{1}{C(1 + zD_e)}.$$

The factor $\frac{1}{C}$ is called the shape magnification of the corrective lens (E. D. Tillyer) and is designated by S; that is,

$$(10) \qquad S = \frac{1}{C} = \frac{1}{1 - dD_1}.$$

The factor $\frac{1}{1 + zD_e}$ may be called the power magnification of the combined system (the corrective lens plus the eye) and may be designated by P; that is,

$$P = \frac{1}{1 + zD_e}.$$

Formula 9 may be symbolized, therefore, by

$$\frac{I_a}{I_e} = S \cdot P.$$

If the distance from F_o, the anterior focus of the eye, to the cornea is assumed to be 15.71 mm. (Gullstrand), the quantity z is defined by the equation

$$z = \frac{15.71 - h}{1{,}000},$$

in which h is in millimeters, the distance from the back vertex of the lens to the cornea. In the majority of cases the value of h lies between 12 and 14 mm.; consequently, the value of z is usually small. Since d $(= \frac{t}{n})$, the "reduced" thickness of the lens, is also small, the percentage by which I_a differs from I_e is approximately

$$(11) \qquad \%\ \text{mag.} = \frac{dD_1 - zD_e}{10},$$

where d and z are to be expressed in millimeters.

CORRECTION OF AN AMETROPIC EYE BY A CONTACT LENS

In order to apply the preceding results to contact lenses, it is to be observed that correction of ametropia by contact lenses may be considered to be achieved by the combination of two lenses: The glass lens, that is, the corneal portion of the contact lens proper and a fluid lens consisting of physiologic solution of sodium chloride. The front surface of the fluid lens is formed by the back surface of the glass lens, and the back surface of the fluid lens is formed by the cornea of the eye (fig. 2). From a theoretical point of view, it will be advantageous to

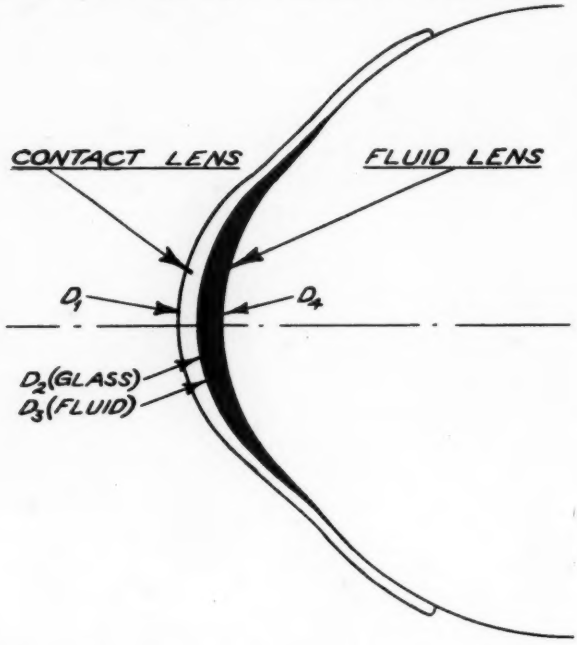


Fig. 2.—Diagram illustrating correction of an ametropic eye by a contact lens.

consider the fluid lens separated from the glass lens as well as from the cornea by an infinitely thin layer of air (Hartinger). Instead of two surfaces, D_1 and D_2, as in the case of an ordinary spectacle lens, there will then be four surfaces, D_1, D_2, D_3 and D_4.

When equation 3 is developed for an optical system of four surfaces separated by media of thicknesses t_1, s and t_2 and of refractive indexes n_1, 1 and n_2, the expression A assumes the following form:[3]

$$A = (D_1 + D_2 - d_1D_1D_2)(1 - d_2D_4) + (D_3 + D_4 - d_2D_3D_4)(1 - d_1D_1) - (D_1 + D_2 - d_1D_1D_2)(D_3 + D_4 - d_2D_3D_4)s,$$

$$\text{where } d_1 = \frac{t_1}{n_1} \text{ and } d_2 = \frac{t_2}{n_2}.$$

3. Ogle, K. N.: The Correction of Aniseikonia with Ophthalmic Lenses, J. Optic. Soc. America **26**:323, 1936.

Since the air space s between the contact lens and the fluid lens is zero, A reduces as shown in the formula

(12)

$$A = (D_1 + D_2 - d_1D_1D_2)(1 - d_2D_4) + (D_3 + D_4 - d_2D_3D_4)(1 - d_1D_1).$$

The corresponding (reduced) form of C is expressed as

(13)

$$C = -(D_1 + D_2 - dD_1D_2)\ d_2 + (1 - d_2D_3)\ (1 - d_1D_1).$$

The effective power, D_e, of the two lenses in succession (doublet) is therefore (compare equation 5) shown by the formula

$$D_e = \frac{A}{C} = \frac{(D_1 + D_2 - d_1D_1D_2)\ (1 - d_2D_4) + (D_3 + D_4 - d_2D_3D_4)\ (1 - d_1D_1)}{-(D_1 + D_2 - d_1D_1D_2)d_2 + (1 - d_2D_3)\ (1 - d_1D_1)}.$$

When the effective power of the glass lens is denoted by D_{e1}, that is,

$$D_{e1} = \frac{D_1 + D_2 - dD_1D_2}{1 - d_1D_1},$$

and the effective power of the fluid lens by D_{e2}, that is,

$$D_{e2} = \frac{D_3 + D_4 - d_2D_3D_4}{1 - d_2D_3},$$

D_e may be written in the form

$$D_e = \frac{D_{e1}(1 - d_1D_1)\ (1 - d_2D_4) + D_{e2}(1 - d_2D_3)\ (1 - d_1D_1)}{D_{e1}(1 - d_1D_1)d_2 + (1 - d_2D_3)\ (1 - d_1D_1)}$$

$$= \frac{D_{e1}(1 - d_2D_4) + D_{e2}(1 - d_2D_3)}{-d_2D_{e1} + (1 - d_2D_3)}.$$

According to formula 10, the following abbreviated notation may be introduced:

$$1 - d_2D_3 = \frac{1}{S_2},$$

where S_2 represents the shape magnification of the fluid lens. Since

$$(1 - d_2D_3)\ (1 - d_2D_4) = 1 - d_2(D_3 + D_4 - d_2D_3D_4)$$
$$= 1 - d_2D_{e2}(1 - d_2D_3)$$
$$= 1 - d_2D_{e2}\frac{1}{S_2},$$

it follows that

$$1 - d_2D_4 = S_2 - d_2D_{e2}.$$

Substitution of these expressions in the equation defining D_e gives

$$D_e = \frac{D_{e1}(S_2 - d_2D_{e2}) + D_{e2}\frac{1}{S_2}}{\frac{1}{S_2} - d_2D_{e1}}$$

$$= \frac{D_{e1}S_2^2 + D_{e2}(1 - d_2S_2D_{e1})}{1 - d_2S_2D_{e1}},$$

and finally

(14)

$$D_e = \frac{D_{e1}S_2^2}{1 - d_2S_2D_{e1}} + D_{e2}.$$

This relation shows that for a given ametropia (D_e = constant) there are theoretically infinitely many ways of achieving the correction.[4]

4. An ametropic eye is considered corrected when the principal focus of the corrective optical system (of effective power D_e) coincides with the far point of the eye.

In particular, it is immaterial from a dioptric point of view what the individual powers of the glass lens and the fluid lens are, as long as the sum of the two terms in formula 14 is equal to the required correction, D_e.

The simplest case arises when the glass lens is a so-called afocal or zero power lens, that is, when

$$D_{e1} = 0.$$

Then

$$D_e = D_{e2},$$

which means that the ametropia is corrected by the optical effect of the fluid lens alone.

If an afocal glass lens is used in the correction of hyperopia, the fluid lens (in analogy to spectacle lenses) is positive; if it is used in the correction of myopia, the fluid lens is negative.

Since the back surface, D_4, of the fluid lens is determined by the cornea (the radius of which is assumed to be measurable), the front surface, D_3, is uniquely determined by the equation

$$D_e = D_{e2} = \frac{D_3 + D_4 - d_2 D_3 D_4}{1 - d_2 D_3};$$

that is,

$$(15) \qquad D_3 = \frac{D_e - D_4}{1 + d_2(D_e - D_4)}.$$

For convenience, the correspondence between the surface powers and the respective radii for $n_f = 1.336$, the assumed refractive index of the fluid lens, and for $n_g = 1.516$, the assumed refractive index of the glass lens, is given in the table. The evaluation of formula 15 for various corneal radii (r_4) and various degrees of ametropia (D_e)

Correspondence Between the Radius, the Surface Power and the Shape Magnification of Contact Lenses

Radius (r) (Mm.)	Power of Glass Surface, D. (D_g) ($n_g = 1.516$)	Power of Fluid Surface, D. (D_f) ($n_f = 1.336$)	Shape Magnification of Glass Lens (S_1) ($n_g = 1.516$) ($t_1 = 0.5$ Mm.)	Shape Magnification of Fluid Lens (S_2) ($n_f = 1.336$) ($t_2 = 0.5$ Mm.)
5.0	103.20	67.20	1.035	1.026
5.5	93.82	61.09	1.032	1.023
6.0	86.00	56.00	1.029	1.021
6.5	79.38	51.69	1.027	1.020
7.0	73.71	48.00	1.025	1.018
7.5	68.80	44.80	1.023	1.017
8.0	64.50	42.00	1.022	1.016
8.5	60.71	39.53	1.020	1.015
9.0	57.33	37.33	1.019	1.014
9.5	54.32	35.37	1.018	1.013
10.0	51.60	33.60	1.017	1.013
10.5	49.14	32.00	1.017	1.012
11.0	46.91	30.55	1.016	1.011

is recorded in figure 3. The thickness of the fluid lens is assumed to vary from 0.2 mm. for lenses of high negative power to 1 mm. for lenses of high positive power. Since the radius of D_3 is equal to the radius (r_2) of the back surface of the glass lens, the results are given in terms of this radius.

The findings in figure 3 may be applied in the following ways:

(*a*) If D_e and r_4 are known, r_2 of the corrective afocal contact lens is determined by reading on the vertical scale the position of the intersection of the vertical line denoted by D_e with the curve denoted by r_4.

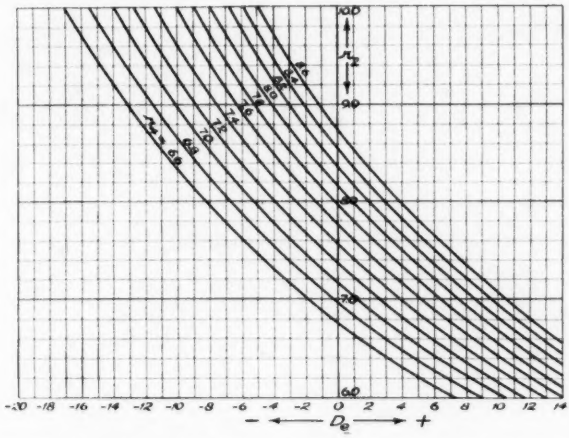


Fig. 3.—Graph showing evaluation of formula 15 for various corneal radii (r_4) and various degrees of ametropia (D_e).

Examples: Given

$D_e = +5.00$ D., $r_4 = 7.5$ mm.,

then $r_2 = 6.9$ mm.

Given $D_e = -15.00$ D., $r_4 = 6.8$ mm.,

then $r_2 = 9.85$ mm.

(*b*) If r_4 and r_2 are known, the amount of ametropia, D_e, which is corrected by the afocal contact lens is determined by reading on the horizontal scale the position of the intersection of the horizontal line denoted by r_2 with the curve denoted by r_4. If this value for D_e differs from the required correction, the difference in power has to be supplied otherwise.

Examples:

$r_4 = 8$ mm., $r_2 = 7.5$ mm.

(Amount corrected) $D_e = 4.00$ D.

If the desired correction is 6.00 D., 2.00 D. has to be supplied otherwise. $r_4 = 7.00$ mm., $r_2 = 8.5$ mm.

(Amount corrected) $D_e = -7.75$ D.

If the desired correction is —2.00 D, + 5.75 D. has to be supplied otherwise.

In cases of corneal astigmatism it is immaterial for which principal meridian these calculations are made, since the results will necessarily be the same for each.

(*c*) If r_4 cannot be measured but full correction is achieved by an afocal contact lens of a known r_2 plus an additional spectacle power, D_{ea} (referred to the cornea), the r_2' which would incorporate this D_{ea} in the fluid lens is found by selecting any r_4, determining for this r_4 and the given r_2 the corresponding D_e, and finally determining the r_2' corresponding to the correction $D_e + D_{ea}$ and the same (fictitious) r_4.

Example:

$r_2 = 8.00$ mm., $D_{ea} = -3.00$ D.

Choose $r_4 = 7.6$ mm. Then $D_e = -1.37$ D.

For $D_e + D_{ea}$ and $r_4 = 7.6$ mm., $r_2' = 8.6$ mm.

In many cases the inner radius (r_2) of the contact lens is not chosen to satisfy optical considerations but is selected to insure the best possible fit. The procedure is usually this:

First, the all important problem of comfort has to be solved; then ordinary refractive methods determine what modifications have to be made optically to give full correction.

Let it be supposed that an eye wearing a contact lens requires for correction an additional power, D_{ea}. If in the test this power was effective at a point h m in front of the contact lens, the power of the front surface, D_1, of the contact lens has to be altered by the amount

$$D_{ea}' = \frac{D_{ea}}{1 - hD_{ea}}$$

COMPARATIVE SIZE OF RETINAL IMAGES

The investigation of the comparative size of the retinal images formed in axially ametropic eyes corrected by contact lenses is carried out similarly to that shown in connection with spectacle lenses.

Again the ratio

$$\frac{I_a}{I_e} = \frac{A_e}{A'}$$

is to be considered. I_a is the retinal image formed by the corrected ametropic eye, and I_e that formed by an emmetropic eye of equivalent power, A_e. A' is the equivalent power of the combined system, the contact lens and the eye, of equivalent powers, A and A_e, respectively. Thus

$$A' = A + A_e - tAA_e.$$

The quantity t may be written

$$t = H'H_o = H'V + VH_o,$$

where H′ is the second principal point of the contact lens system, V is the vertex of the back surface, D_4, of the fluid lens which coincides with the vertex of the cornea, and H_o is the first principal point of the eye. For any optical system the location of the second principal point with reference to the vertex of the last surface is given by

$$VH' = \frac{C-1}{A},$$

where A and C are the constants of equation 3 derived for the given system.

If the distance VH_o is denoted by b, t may be written in the form

$$t = -\frac{C-1}{A} + b.$$

After substitution it follows that

$$\begin{aligned} A' &= A + A_o - (-\frac{C-1}{A} + b)AA_o \\ &= A + A_o + CA_o - A_o - bAA_o \\ &= A + CA_o - bAA_o, \end{aligned}$$

and since

$$A = CD_e,$$

$$\begin{aligned} A' &= CD_e + CA_o - bCD_eA_o \\ &= C(D_e + A_o - bD_eA_o). \end{aligned}$$

Therefore, the ratio $\frac{I_a}{I_e}$ takes the form

$$\frac{I_a}{I_e} = \frac{1}{C} \cdot \frac{A_o}{(D_e + A_o - bD_eA_o)} = SP, \tag{16}$$

where $S = \frac{1}{C}$ is called the shape magnification of the contact lens system and

$$P = \frac{A_o}{D_e + A_o - bD_eA_o} \tag{17}$$

may be called the power magnification of the combined system, glass lens, fluid lens and eye.

The values $A_o = 58.64$ D. and $b = 1.348$ mm. (Gullstrand) being assumed, the quantity P has been evaluated as a function of D_e (the amount of ametropia) and has been plotted in figure 4. For example, if $D_e = -10.00$ D., $P = 1.186$, or, expressed differently, a contact lens system of—10.00 D. has a power magnification of 18.6 per cent.

The term magnification is employed for the ratio of the retinal image of a corrected ametropic eye and that of an emmetropic eye.

If $D_e = +10.00$ D., $P = 0.864$, or the power magnification is —13.6 per cent (minification).

The power magnification, P, is independent of the shape of the contact lens system; that is, it is the same for a given D_e, regardless of the particular powers and thicknesses which the glass lens and the fluid lens may have in an individual case. The total magnification is obtained by multiplying the power magnification as given in figure 4 by the shape magnification, S.

The shape magnification, S, was defined as

$$S = \frac{1}{C} = \frac{1}{-(D_1 + D_2 - d_1D_1D_2)d_2 + (1 - d_2D_3)(1 - d_1D_1)}.$$

After the substitutions

$$D_1 + D_2 - d_1D_1D_2 = D_{e1}(1 - d_1D_1)$$
$$1 - d_1D_1 = \frac{1}{S_1}$$
$$1 - d_2D_3 = \frac{1}{S_2}$$

S takes the form

$$S = \frac{S_1S_2}{1 - d_2S_2D_{e1}}. \quad (18)$$

For afocal contact lenses ($D_{e1} = 0$)

$$S = S_1S_2.$$

An idea of the magnitude of this quantity is formed when reference is made to the table, which gives the S_1 and S_2 values for the thicknesses

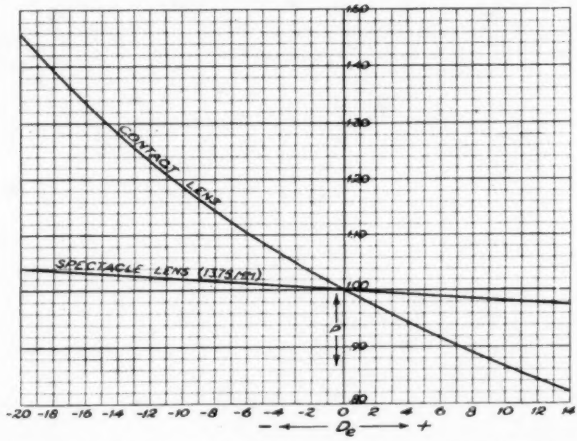


Fig. 4.—Graph showing power magnification (P) plotted against the amount of ametropia (D_e).

$t_1 = t_2 = 0.5$ mm. For instance, in order to obtain an estimate of the shape magnification produced by an afocal contact lens of an inner radius $r_2 = 7.5$ mm., 1.023, the value of S_1 for the same radius (since r_1 and r_2 of an afocal lens are approximately equal) is to be multiplied by 1.017, the value of the corresponding S_2. The result is approximately $S = 1.04$ (the figures after the decimal point are simply added), or $S = 4$ per cent.

In the general expression for S (formula 18) sufficient accuracy will be gained by retaining only the terms of the first order among those containing d_1 and d_2, since the values of d_1 and d_2 are always very small. Thus S may be approximately expressed in the form

$$S = 1 + d_1D_1 + d_2D_3 + d_2D_{e1}$$
$$= 1 + d_1(D_e - D_2 - D_3 - D_4) + d_2D_3 + d_2(D_e - D_3 - D_4)$$
$$= 1 + (d_1 + d_2)(D_e - D_4) - d_1(D_2 + D_3).$$

The radius of the surface D_4 is determined by the radius of the cornea. The surfaces D_2 and D_3 are not independent of each other; by definition

$$D_2 = \frac{1 - n_g}{r_2}$$

$$D_3 = \frac{n_f - 1}{r_3}.$$

Since $r_2 = r_3$, it follows that

$$D_2 + D_3 = \frac{n_f - n_g}{r_2} = D_{23}.$$

Therefore, approximately,

$$S = 1 + (d_1 + d_2)(D_e - D_4) - d_1 D_{23}. \tag{19}$$

This equation is of great interest in aniseikonia, because an estimate of the possible variation in size of retinal images by means of contact lenses can be easily obtained from it. The extent of this variation, which is due solely to shape characteristics of contact lenses, will largely determine their usefulness in the correction of aniseikonia, since the power magnification is a fixed quantity dependent only on the ametropic error (D_e).

If the shape magnification which corresponds to a contact lens system when

$t_1 = 0.5$ mm., $n_g = 1.516$
$t_2 = 0.5$ mm., $n_f = 1.336$
$r_2 = 8$ mm.
$r_4 = 7.7$ mm.
$D_e = 0$

is introduced as "basic" shape magnification, S of formula 19, expressed in percentage, is approximately

$$S\,\% = 3.81 + 0.44\,\Delta t_1 + 0.33\,\Delta t_2 - 0.01\,\Delta r_2 - 0.04\,\Delta r_4 + 0.07 D_e. \tag{20}$$

In this equation the constant 3.81 per cent is the basic magnification; Δt_1, Δt_2, Δr_2 and Δr_4 are the increments of the indicated quantities. They are to be expressed in tenths of a millimeter and are positive when the given quantities are larger than those chosen for the basic magnification; they are negative when the given quantities are smaller. For instance, if t_1 is 0.1 mm. larger than 0.5 mm. ($\Delta t_1 = 1$), the magnification is 0.44 per cent larger; if t_2 is 0.1 mm. smaller than 0.5 mm. ($\Delta t_2 = -1$), the magnification is 0.33 per cent smaller. Thus, the shape magnification for a contact lens system when

$t_1 = 0.7$ mm.
$t_2 = 0.3$ mm.
$r_2 = 7.5$ mm.
$r_4 = 7.5$ mm.
$D_e = +4.00$ D.

is approximately

$$S\,\% = 3.81 + 0.44 \times 2 + 0.33 \times (-2) - 0.01 \times (-5) - 0.04 \times (-2) + 0.07 \times 4 = 4.44.$$

Equation 20 shows that of those quantities which (in certain limits) may be chosen arbitrarily, namely, t_1, t_2 and r_2, only changes of t_1 and t_2 can affect the magnification appreciably.

Let it be assumed that a test for aniseikonia is made after the dioptric condition of a patient has been fully corrected by means of contact lenses. Always under the hypothesis that the required thicknesses (say, from $t_1 + t_2 = 0.6$ mm. up to $t_1 + t_2 = 2$ mm.) are physically possible, can be tolerated by the eye and are adequately controllable in the process of fitting, it can be said that in extremely favorable cases iseikonic differences up to 5 per cent can be corrected by changing the shape qualities of contact lenses. If, instead of 2 mm., 1 mm. is considered as the maximum tolerance for $t_1 + t_2$, the figure drops to only about 1.5 per cent.

It seems, therefore, that the significance of contact lenses as a corrective means in aniseikonia does not rest so much on the variability of magnification due to changes in thickness but is evident in those favorable cases in which the power magnification and the basic shape magnification can be used to equalize otherwise existing differences in size.

It is to be noted, however, that a remarkable variability of magnification is available when spectacle lenses are used in combination with contact lenses. The reason for this is to be found in the fact that the power magnification of contact lenses changes much more rapidly with D_e than the power magnification of single lenses (fig. 4[5]). For instance, in order to increase the magnification of an emmetropic eye, it can be made artificially hyperopic by means of a contact lens of negative D_e which will increase the magnification of the combined system (the contact lens and the eye). Then, while the error in power can be offset by an ordinary spectacle lens, the increase of magnification cannot be offset completely. There will remain a residual magnification, which is, of course, the magnification of the small galilean telescope consisting of the positive spectacle lens and the negative contact lens system. The index c being used for all quantities referring to the contact lens and the index s for those referring to the spectacle lens, the telescopic magnification is given by the formula

$$M = -\frac{A_c}{A_s} = -\frac{D_{ec}S_s}{D_{es}S_c}.$$

If the power D_{es} of the spectacle lens is effective at h m. in front of the contact lens, D_{ec} is approximately [6] given by

$$D_{ec} = \frac{-S_c^2 D_{es}}{1 - hD_{es}}.$$

5. The D_e' of the spectacle lens at h m. from the cornea, is, of course, different from the D_e of the contact lens correcting the same ametropic error. The two powers are related by

$$D_e = \frac{D_e'}{1 + hD_e'}.$$

6. If the glass lens is afocal, the exact expression is

$$D_{ec} = \frac{-S_c^2 D_{es}}{1 - D_{es}(h + S_1 d_1 + S_1^2 S_2 d_2)}.$$

Therefore, the telescopic magnification may be expressed approximately in the form

$$M = S_c S_s \left(\frac{1}{1 - hD_{es}}\right). \tag{21}$$

According to this formula, the telescopic magnification for $D_{es} = +8.00$ D., $h = 0.013$ m., $S_c = 1.04$, and $S_s = 1.03$ is approximately 1.2, or 20 per cent.

A good example of these methods of changing differences in size is the important case of monocular aphakia.

An aphakic eye assumed to be normal in all other respects has a total power of 43.00 D. Its first principal point can be assumed to coincide with the vertex of the cornea. If such an eye is corrected by an ordinary spectacle lens, the retinal image is about 25 per cent larger than that for an emmetropic eye (the shape and position of the lens being conditional factors). If the other eye is assumed to be emmetropic, the difference of 25 per cent in the size of the retinal image, in general, is a deciding factor in making single binocular vision impossible. In the event that the aphakic eye is corrected by a contact lens of power $D_c = 11.75$ D., the retinal image of the aphakic eye compared to that of the emmetropic eye is (according to equation 16)

$$\frac{I_a}{I_e} = S. \frac{A_o}{D_e + A_a - bD_eA_a},$$

where

$$A_o = 58.64 \text{ D.}$$
$$A_a = 43.00 \text{ D.}$$
$$b = 0.$$

It follows that

$$\frac{I_a}{I_e} = S.\ 1.071.$$

If S is 1.04, the total difference in size expressed in percentage is 11.40. The reduction of the magnification from 25 to 11.4 per cent is due to the power magnification (minification) of the contact lens. In order partially to wipe out this remaining difference, a contact lens of power $D_e = 0$ could be worn on the emmetropic eye the basic shape magnification (about 4 per cent) of which should be increased as much as is tolerated by the eye by choosing a large thickness for t_1 or t_2 or for both. Thus, in a favorable case, the difference in size of the retinal images may be reduced to only about 6 per cent.

If, however, spectacle lenses are used in addition to contact lenses, the difference in size of 11.4 per cent which remains after the correction of the aphakic eye by a contact lens (plus the shape magnification of the zero power spectacle lens in front of the aphakic eye) can be easily wiped out according to formula 21, if the emmetropic eye is made about 3 D. hyperopic by a contact lens and is then corrected with an ordinary spectacle lens.

ADIE'S SYNDROME

REPORT OF CASES

FOSTER KENNEDY, M.D.

HERMAN WORTIS, M.D.

J. D. REICHARD, M.D.

AND

B. B. FAIR, M.D.

NEW YORK

Sir William Osler many years ago characterized syphilis as "the great imitator" because it can simulate or complicate nearly every condition known in the field of internal medicine. The converse of Dr. Osler's statement is that many of the conditions known in the field of internal medicine can simulate syphilis. But while the original dictum has become a familiar part of medical training, its logical converse has received little attention.

It is our purpose in this paper to draw attention to a symptom complex which has repeatedly been mistaken for syphilis of the central nervous system. Many unfortunate persons presenting it have been treated for tabes dorsalis, and in some instances it has played a major role in disrupting family life and leading to a vast amount of unnecessary anxiety and misery. Ordinarily it presents a rather simple picture, consisting merely in tonic reactions of one or both pupils and in the absence of some or all of the deep tendon reflexes.

The myotonic pupillary reaction was first described in 1902 by Saenger [1] and Strasburger,[2] reporting independently. Markus [3] in 1905 reported before the British Ophthalmological Society a case in which the patient showed a myotonic pupil with absence of the knee jerks and ankle jerks. In 1931, under the title "Pseudo-Argyll Robertson Pupils with Absent Tendon Reflexes: A Benign Disorder Simulat-

---

Read before the New York Academy of Medicine, Section of Ophthalmology, Oct. 18, 1937.

From the Neurological Service, the Bellevue Hospital, and the Neuropsychiatric Service, the United States Marine Hospital, Ellis Island.

1. Saenger, A.: Ueber myotonische Pupillenbewegung, Neurol. Centralbl. **21**:837, 1902.

2. Strasburger, J.: Pupillentragheit bei Akkomodation und Convergenz, Neurol. Centralbl. **21**:1388 and 1052, 1902.

3. Markus, C.: Notes on a Peculiar Pupil Phenomenon in Cases of Partial Iridoplegia, Tr. Ophth. Soc. U. Kingdom **26**:50, 1906.

ing Tabes Dorsalis" Adie [4] reported a study of six persons. In all his cases one or both pupils showed either very poor reaction to light or none at all, and a tonic slow reaction on convergence, with even slower subsequent dilatation. There was also some loss of deep tendon reflexes in all the cases. The presence of syphilis was ruled out in each person, and no other neurologic signs were noted. The following year R. Foster Moore [5] and Gordon Holmes [6] presented similar cases before the Ophthalmological Society of the United Kingdom. Moore,[7] as a matter of fact, had presented such cases before the society in 1924, but his neurologic data were incomplete.

In 1932 Adie [8] again presented his material, to which he had added much in the meantime, and characterized the syndrome as "a benign disorder sui generis." He was able at this time to report nineteen cases of his own, in thirteen of which tendon reflexes were absent and in six of which only pupillary changes were seen. He also collected and reviewed forty-five published cases, in nine of which tendon reflexes were absent. Many of Adie's patients had been followed over a period of years, without any evidence of syphilis or any additions to the neurologic picture.

Weber [9] in 1933 was able to reexamine Markus' [3] patient with a "myotonic" pupil after an interval of twenty-seven years. The patient still had a tonic right pupil, smaller than at the time of the original report; the patellar and achilles reflexes were still absent. The subject was entirely well, was working, was married and had two healthy children. The blood serum gave negative Wassermann and Meinicke reactions. No similar pupillary phenomena had been discovered among his relatives. Other patients have also been followed for long periods, with similar findings.[10] Rudolf [11] reported the syndrome occurring in a

4. Adie, W. G.: Pseudo-Argyll Robertson Pupils with Absent Tendon Reflexes: A Benign Disorder Simulating Tabes Dorsalis, Brit. M. J. **1**:928, 1931.

5. Moore, R. F.: The Non-Luetic Argyll-Robertson Pupil, Tr. Ophth. Soc. U. Kingdom **51**:203, 1932.

6. Holmes, G.: Partial Iridoplegia Associated with Symptoms of Other Diseases of the Nervous System, Tr. Ophth. Soc. U. Kingdom **51**:209, 1932.

7. Moore, R. F.: Physiology and Pathology of Pupil Reactions, Tr. Ophth. Soc. U. Kingdom **44**:38, 1924.

8. Adie, W. J.: Complete and Incomplete Forms of the Benign Disorder Characterized by Tonic Pupils and Absent Tendon Reflexes, Brit. J. Ophth. **16**: 449, 1932.

9. Weber, F. P.: Report on Dr. Markus's Original Case, Proc. Roy. Soc. Med. **26**:530, 1933.

10. Barré, J. A., and Klein, M.: Adie Syndrome Case, Rev. neurol. **1**:590, 1934.

11. Rudolf, G. de M.: Tonic Pupils with Absent Tendon Reflexes in Mother and Daughter, J. Neurol. & Psychopath. **16**:367, 1936.

mother and her daughter. The tonic pupillary reaction had been present in the mother for a period of thirty-two years. Such patients, followed over a period of years, offer presumptive evidence that the syndrome described by Adie is benign.

The syndrome may be present in a complete or an incomplete form. The complete form is regarded as that in which one or both pupils fail to react normally to light and have a tonic convergence reaction and in which there is absence of one or more deep tendon reflexes. The incomplete form may consist of: (*a*) tonic pupillary reactions alone, (*b*) atypical phases of tonic pupillary reactions alone, (*c*) atypical pupils with absence of tendon reflexes and (*d*) absence of tendon reflexes alone.

Of major importance in recognizing the syndrome is the differential diagnosis between the Argyll Robertson pupil and the tonic or myotonic pupil. The disorder of the pupil described by Argyll Robertson [12] has the following characteristics: (*a*) the pupil is miotic; (*b*) the condition is bilateral; (*c*) the accommodation or the convergence reaction is normal or overactive; (*d*) the pupil is fixed to light, and (*e*) it reacts poorly to mydriatics.

The tonic or myotonic pupil, on the other hand, presents the following characteristics: (*a*) The condition is unilateral in 80 per cent of cases. (*b*) The affected pupil is usually larger than its fellow; that is, the pupils are unequal. (*c*) During accommodation, after a short delay, the pupil contracts to a degree often greatly in excess of normal. It may then remain small for several minutes after the act of convergence has ceased, after which dilatation proceeds at a much slower rate than contraction. (*d*) The direct and consensual reactions to light, as ordinarily tested, are completely or almost completely abolished. However, after the subject has been in a dark room the pupil *does* dilate, and on subsequent exposure to daylight contracts very slowly again. Contraction may proceed until the pupil becomes considerably smaller than it was before dilatation in the dark room. Then it again dilates very slowly to its original size. The reaction to bright light after dilatation may take several minutes. (*e*) The pupil reacts normally and completely to mydriatics.

We now report the following cases:

REPORT OF CASES

CASE 1.—H. G., a single white American man, was admitted to the State Psychopathic Hospital at the University of Michigan on March 25, 1932. He came to the clinic because of a state of chronic anxiety, pains in his head, and

12. Merritt, H. H., and Moore, M.: The Argyll Robertson Pupil, Arch. Neurol. & Psychiat. **30**:357 (Aug.) 1933.

multiple phobias, especially the fear of insanity. There was also evidence of latent homosexuality. His illness consisted of a set of phobias rooted in this homosexuality and of a state of chronic anxiety with periodic outbursts of acute panic, which rested, in turn, on the phobias.

Physical examination gave entirely normal findings except that the right pupil was larger than the left and each reacted fairly well to light but very poorly in accommodation. The knee jerks and ankle jerks were absent. There was vasomotor instability, with constantly changing mottled cutaneous patterns and marked dermographia. These serologic reactions of the blood and spinal fluid were normal, as were the results of all the other laboratory tests. The patient returned to the clinic one year later, at which time the right pupil was still larger than the left. Both reacted very sluggishly to light but were especially tonic in their reaction to accommodation, taking over sixty seconds to reach their full degree of contraction. Then, in a darkened room, they dilated even more slowly, requiring one hundred and twenty seconds to reach the peak of their dilatation.

The patient's mental state was by now much improved. He was therefore discharged.

In summary, a 20 year old single man entered the hospital for a state of chronic anxiety. Subsequent psychiatric examination revealed marked evidence of latent homosexuality. Physical examination revealed definite evidence of Adie's syndrome in the nature of a tonic right pupil and absence of deep reflexes in the lower extremities. It is of interest that the reactivity of the pupil varied with the patient's emotional state. Syphilis was suspected as the organic cause in this case until the appearance of Adie's paper made apparent the benign nature of this patient's condition.

CASE 2.—J. B., a 28 year old single man of Jewish extraction, was admitted to the Bellevue Hospital on Nov. 5, 1932, because he complained of blurred vision and a large left pupil, which he stated had followed the draining of both maxillary sinuses in June 1932. He recalled, however, that twelve years previously his roommate (a premedical student) had been unable to obtain any knee jerks from him. The past history and family history were irrelevant except that the patient's mother had died in 1931 after becoming mentally deranged.

The patient was exceedingly well developed. Physical examination showed no abnormality except that the left pupil was enlarged and fixed to light and in accommodation. There was also no consensual reaction from left to right. In addition, the knee jerks and ankle jerks were not obtainable. Psychiatric examination revealed that this patient was suffering from a severe anxiety neurosis, and Dr. Aaron Bell, who has followed the patient since his discharge, stated that he has had recurrent attacks of acute homosexual panic.

The patient was again seen on June 24, 1936. On this occasion the left pupil was smaller than the right and still fixed to light and in accommodation, with loss of consensual reaction from left to right. The knee jerks and ankle jerks were still absent. There was no longer blurring of vision. The patients spontaneously made the following remark: "This pupil is the best indication of my personality that I know. When I'm excited you can't see any color in my

eye; when I'm calm the pupil is small, as it is now, and it will sometimes show a slight reaction to light." Three weeks previously the patient had another Wassermann test of the blood made because "Every doctor I see insists I have at least ten plus syphilis."

In summary, a 28 year old unmarried Jewish-American man who entered the hospital complaining of blurred vision presented a typical Adie's syndrome (incomplete) in the nature of a large, fixed left pupil and absence of deep reflexes in the lower extremities. A psychiatric survey revealed that the patient had an anxiety neurosis with marked evidence of latent homosexuality. In this case, too, there was evidence that the emotional state of the patient affected the size and reactivity of the left pupil. In this case, again, syphilis had been suggested to the patient as an etiologic factor by so many physicians that he had a definite syphilophobia.

CASE 3.[13]—M. McC., an Irish woman aged 33, was admitted to the United States Marine Hospital at Ellis Island because a previous examination had revealed "a fixed left pupil and absent patellar and achilles reflexes."

She would admit to no complaints—a common occurrence in immigrants who are anxious to enter this country. She did, however, state that the left pupil had been smaller than the right since birth. She denied having had defective vision at any time.

General physical examination gave entirely normal findings. The blood pressure was 145 systolic and 90 diastolic on admission, but varied a good deal.

Neurologic examination showed unequal pupils, the left being smaller than the right. The right pupil reacted to light and in accommodation; the left reacted to neither and showed definite hippus. All the deep reflexes were absent and could not be obtained with reenforcement. The Wassermann reactions of the blood and spinal fluid were negative. Chemical studies and studies of the blood showed no abnormality.

Since the patient did not stay at the hospital for any length of time, no complete psychiatric survey could be made, nor could we judge the effect of emotion on the condition.

In summary, a 33 year old unmarried Irish immigrant woman with no complaints was sent to the United States Public Health Service for further check-up because syphilis was suspected. Examination revealed that her condition corresponded to the third incomplete type of Adie's syndrome, that is, atypical pupils with absence of deep reflexes. There was also some evidence of autonomic imbalance in the form of moist extremities and a relatively labile blood pressure.

CASE 4.—I. A., a 37 year old Jewish-American man, was seen in private practice on April 7, 1937. He had no complaints but had been unable to obtain insurance for ten years because he was told that he "probably had burned-out

13. This case was previously reported by S. B. Wortis and J. D. Reichard: Adie's Syndrome, Hosp. News **2**:14, 1935.

tabes." In addition, he had delayed marrying the woman of his choice for seven years because he was afraid of the consequences. He had had nineteen Wassermann tests of the blood and one Wassermann test of the spinal fluid, which were negative. Despite this, no physician was willing to assure him that he did not have syphilis, and he had already undergone several modified therapeutic regimens.

Physical examination gave entirely normal findings except that both pupils were large, slightly irregular and absolutely fixed to light and in accommodation. They did, however, dilate very promptly after mydriatics were used. All the deep reflexes were absent. Neurologic examination otherwise showed no abnormality. After several hours in a dark room the pupils reacted sluggishly to light and after a prolonged latent period showed a good reaction in accommodation. The Wassermann reactions of the blood and spinal fluid were negative. We have had no opportunity to follow this patient. A sister and two brothers were examined; no evidence of Adie's syndrome was found in any of them.

In summary, a 37 year old Jewish-American man sought medical advice because he had been repeatedly told that he had syphilis. Examination revealed that the patient had a typical Adie's syndrome, with tonic pupils, absence of deep reflexes and negative serologic reactions. Since receiving our assurance that he had a benign condition he has made plans to marry.

CASE 5.—E. T., a 28 year old American housewife, was seen in private practice on April 28, 1937. She complained of severe occipital headache, which was persistent and which on occasion migrated over the vertex of the skull. This headache had been present for eighteen months. Four months before she was seen by us her local physician told her that she had a rigid right pupil and gave her a course of injections of tryparsamide. Another physician had told the husband that his wife had either latent syphilis or a tumor of the brain.

Physical examination gave entirely negative results except that the right pupil was seen to be irregular, larger than the left, completely fixed to light and showing a definite tonic reaction in accommodation. The knee jerks and ankle jerks were absent, even with reenforcement. The right iris showed atrophy of the pigmented borders in the lower and outer quadrants. The husband was a coarse, difficult person, and it was felt that the patient's headache might well be a reaction against a troublesome situation in the home. The Wassermann reactions of the blood and spinal fluid were normal.

The patient was extremely tense, anxious and demanding of attention throughout her stay in the hospital.

The tonic reaction in accommodation persisted, but it was noted that at periods when the patient was not tense a definite reaction to light could be obtained in the right pupil and the reflexes in the lower extremities were readily obtained with reenforcement. The husband refused to accept the fact that no organic cause for his wife's headache was demonstrable and took her home against advice.

In summary, a 28 year old American housewife sought medical advice because of intractable headache of eighteen months' duration. In addition, she had been told previously that she had a rigid right pupil.

Examination revealed that the patient had a typical Adie's syndrome, with a tonic right pupil and absence of deep reflexes in the lower extremities. The serologic reactions were entirely normal. The reaction of the right pupil to light and the presence or absence of deep reflexes in the lower extremities varied according to the patient's emotional state.

COMMENT

In general,[14] the syndrome has been found in healthy young females without other signs of organic nervous disease. It is generally symptomless except for a not uncommon photophobia on passing from a dark to a light place. The ratio as to sex is approximately 5 females to 1 male. Many of the patients give evidence that the ocular signs have been present since childhood; they have lived many years without the appearance of any other signs or symptoms. In thirty-seven of Adie's cases the blood and spinal fluid were examined by the Wassermann test for evidence of syphilis; in eighteen the blood only was examined; all the reactions were negative.

Adie's use of the phrase a benign disorder sui generis has occasioned some discussion. Jelliffe[15] reported having found the syndrome in cases of influenza, encephalitis, diabetes and alcoholic polyneuritis and also described its occurrence in "dysthyroid states." It has also been

14. (*a*) Hassin, G. B., and Thompson, J. J.: Pupillotonia or Tonic Pupils, J. Nerv. & Ment. Dis. **80**:430, 1934. (*b*) Coppez, H.: Adie's Syndrome, Bull. Soc. belge d'opht. **70**:60, 1935. (*c*) Harvier, P., and Boudin, G.: Adie Syndrome in Syphilitic Retinochoroiditis, Paris méd. **1**:177, 1935. (*d*) Muller, H. K.: Pupillotonia and Absent Tendon Reflexes, Ztschr. f. Augenh. **88**:20, 1935. (*e*) Thomas, A., and de Ajuriaguerra, J.: Association of Pupillary Disturbances and of Osteotendinosa Areflexia with Discussion of Adie Syndrome, Rev. neurol. **66**: 78, 1936. (*f*) Barré, J. A., and Helle: Adie Syndrome with Bilateral Pupillary Disturbance, ibid. **1**:542, 1934. (*g*) Bramwell, E.: Holmes-Adie Syndrome, Tr. Med.-Chir. Soc. Edinburgh, 1935-1936, p. 83. (*h*) de Busscher, J.: Pupillotonia and Areflexia of Tendons, J. belge de neurol. et de psychiat. **35**:331, 1935. (*i*) Petit, J.: Adie Syndrome, Helvet. med. acta **3**:238, 1936. (*j*) Brouwer, B.: Pupillotonia Associated with Areflexia of the Extremities, Nederl. tijdschr. v. geneesk. **77**:4880, 1933. (*k*) Schneider, M.: Absent Tendon Reflexes and Tonic Pupils, M. J. Australia **1**:153, 1933. (*l*) Cardona, F.: Adie Syndrome, Riv. di pat. nerv. **48**:188, 1936. (*m*) Subirana, A.: Adie Syndrome, Abolition of Tendon Reflex and Simulation of Argyll Robertson Sign, Arch. de neurobiol. **15**:93, 1935. (*n*) Hubin, R.: Adie Syndrome, Liége méd. **29**:605, 1936. (*o*) Chavany, J. A.: Adie Syndrome, Presse méd. **43**:1243, 1935. (*p*) Adie, W. G.: Tonic Pupils and Absent Tendon Reflexes, Brain **55**:98, 1932.

15. Jelliffe, S. E.: Hypothyroidism and Tabes Dorsalis, New York State J. Med. **31**:363, 1931; The Myotonic Pupil: Contribution and Critical Review, J. Neurol. & Psychopath. **13**:349, 1933.

noted in association with various sympathetic disorders,[16] in various types of psychopathy [17] and even in association with pernicious anemia.[18]

All the aforementioned associations with various diseased conditions have tended to throw doubt on Adie's conception of "a benign disorder, sui generis." The hard fact remains, however, that many cases have been observed carefully in healthy people and over long periods without discovery of any associated organic disease. From a practical standpoint, it seems of little importance whether the syndrome is a disorder sui generis or not. It is, at the very least, a complex of signs of sufficient constancy and of frequent enough occurrence to make it a handy and a necessary tool of differential diagnosis. Adie restricted the syndrome to those cases in which there are no other neurologic signs and to persons who are otherwise in good health. In the interests of diagnostic clarity, it seems logical to follow these restrictions. To report the syndrome in association with every sort of disease is to widen its significance progressively until it loses all meaning and value—a procedure which Adie manifestly never intended.

However, vasomotor instability is also frequently noted in patients presenting this syndrome. Franchel [16] and Harvier and Boudin [14c] reported cases of this condition in which the oculocardiac reflex was absent on one or both sides, and the latter authors spoke of an "unsteady" pulse in connection with their case.

The most interesting question raised by all these observations is, of course, What does a combination of pupillotonia and absence of tendon jerks mean in terms of anatomy, pathology, psychology and physiology? Indeed, why should the two disorders be associated at all? Is there a common etiologic factor in all these cases?

These are difficult questions about which there has been a good deal of theorizing. Some of these theories may be briefly stated. Throughout the French literature there runs a tone of suspicion that in spite of the absence of all clinical findings the syndrome may be due to a form of syphilis which the French writers have called latent. Accordingly, several of them have treated the recognized syndrome with antisyphilitic measures, but without success. Franchel suggested that the syndrome may be a disorder of the vegetative nervous system, a con-

16. Franchel, F.: Tonic Pupils (Adie Syndrome), Gaz. d. hôp. **108**:1665, 1935.

17. Petit, G., and Delmond, J.: Adie Syndrome in Mental Pathology, Ann. méd.-psychol. **94**:497, 1836. Parker, S.; Schilder, P., and Wortis, H.: A Specific Motility Psychosis in Alcoholic Negroes, Arch. Neurol. & Psychiat., to be published. Bromberg, W.: Atypical Case of Syndrome of Tonic Pupils and Absence of Reflexes, ibid. **33**:676 (March) 1935.

18. Petit, G., and Delmond, J.: Adie Syndrome and Polyneuritic Psychosis in Pernicious Anemia, Ann. méd.-psychol. **94**:106, 1936; Transitory Adie Syndrome, Pernicious Anemia and Latent Parkinsonism in Course of Subacute Mental Confusion, ibid. **94**:236, 1936.

genital myotonia accompanied with a muscular lesion in the iris, or due to a lesion of the ciliary ganglion. Adie agreed with Franchel's first suggestion.

It may be clearly seen, then, that at the present time ideas as to the possible etiology are very hazy. Jelliffe in 1921 reached the conclusion that psychogenic factors could cause the picture of Adie's syndrome—but thought that this was done indirectly through an effect on thyroid function. Petit and Delmond found the syndrome in patients with diverse mental troubles, often in association with endocrine and vasomotor difficulties. They suggested the infundibulum as a possible seat of pathologic changes.

In connection with the discussion of this seeming relationship between emotion and Adie's syndrome, the salient features of a case presented by Inman [19] in 1925 are of interest.

> A lady, aged 32, consulted me in 1915 and again in 1916 on account of some difficulty in reading. Beyond a low degree of compound hypermetropic astigmatism, nothing abnormal was found. In May 1921, she attended again complaining of headache. The left pupil was found to be larger than the right and to react to accommodation but not to light. The Wassermann reaction was negative. As she was of the type commonly described as "high strung" I surmised that some shock or grief might have caused the symptom and asked her if she had had any recent bereavement. To my astonishment, she burst into tears and told me of the death of her father, which had occurred, not immediately before, as one might have supposed, but 14 months previously in March 1920. On the anniversary of his death she was on her way to visit his grave and was actually buying a wreath when her sister noticed and commented on the dilatation of her left pupil which was so pronounced as to give her a strange look. I saw her again in March 1922. She was then unaware that it was about the time of the second anniversary of her father's death. The pupils were at first normal in size and reaction but a reference on my part to the old sorrow, whilst evoking no apparent emotion, was yet followed by a dilatation of the left pupil.

It is therefore clear that the combination of Adie's syndrome with emotional disturbances and vasomotor lability is a not uncommon one.

When one searches for some anatomic mechanism which mediates impulses concerned in this triad of conditions, the hypothalamus becomes suspect. It is realized that the idea of relegating any new functions to any area which seems already overloaded with them is one which may not easily be accepted. Evidence [20] has been presented to confirm the

---

19. Inman, J.: The Non-Luetic Argyll Robertson Pupil, Brit. M. J. **2**:1170, 1925.

20. Ranson, S. W., and Magoun, H. W.: Respiratory and Pupillary Reactions Induced by Electrical Stimulation of the Hypothalamus, Arch. Neurol. & Psychiat. **29**:1179 (June) 1933. Karplus, J. P., and Kreidl, A.: Gehirn und sympathicus: I. Zwischenhirnbasis und Halssympathicus, Arch. f. d. ges. Physiol. **129**:138, 1909;

(Footnote continued on next page)

fact that in the hypothalamus closely associated nuclear masses have a large degree of control over pupillary reactions, vasomotor changes and emotional responses. The connections of the hypothalamus with the frontal lobes, the olfactory system, the thalamus, the spinal cord and the pituitary gland provide the anatomic basis for a wide field of influence.

Before closing we wish to emphasize that these cases are presented not so much as an exercise in speculative pathology as to stress the fact that Adie's syndrome is a symptom complex which closely simulates syphilis of the nervous system and is *not* syphilis. We believe that a knowledge of the syndrome is, or should be, an indispensable part of the mental furniture of every physician who undertakes to diagnose syphilis of the central nervous system.

DISCUSSION

DR. FOSTER KENNEDY: An attempt to interpret the signs reported in this paper is really an exercise in speculative pathology. The Argyll Robertson pupil is not merely a syphilitic pupil. It can be found in cases of epidemic encephalitis, and it has been described by men of the highest competence as having occurred in association with multiple sclerosis. I have never seen such a case, but if Kinnier Wilson says that he has, I am sure it is a fact.

I had occasion at the old Neurological Institute on Sixty-Seventh Street to observe a young boy with tumor in the left temporosphenoid region. The tumor was mesially placed and therefore impinged closely on the quadrigeminal bodies. The course followed the progression of tumors of the brain in general in that there were periods when there was increased edema around the tumor. When increased edema and increased intracranial pressure were present, the boy would have severe headaches and acute attacks of vomiting, and signs referable to the quadrigeminal bodies would appear; that is, the child would lose his ability to move his eyes upward and conjugately. At the same time that he lost the ability of conjugate movement of the eyes upward, Argyll Robertson pupils would develop, which would not react to light but still be able to react in accommodation. When the crisis was over, a matter of only a few hours, the pupils returned to normal. Eventually the tumor encroached on the midbrain sufficiently to fix the eyes in mid-position, and by this time the pupils were fixed permanently.

Gehirn und Sympathicus: II. Mitteilung, ein Sympathicuszentrum in Zwischenhirn, ibid. **135**:401, 1910; Gehirn und sympathicus: III. Sympathicusleitung in Gehirn und Halsmark, ibid. **143**:109, 1912; Ueber experimentelle reflektorische Pupillenstarre, Neurol. Centralbl. **32**:82, 1913. Ingram, W. R.; Ranson, S. W.; Hannett, F. I.; Zeiss, F. R., and Terwilliger, E. H.: Results of Stimulation of the Tegmentum with the Horsley-Clark Stereotaxic Apparatus, Arch. Neurol. & Psychiat. **28**:513 (Sept.) 1932. Ranson, S. W., and Magoun, H. W.: The Central Path of the Pupilloconstrictor Reflex in Response to Light, ibid. **30**:1193 (Dec.) 1933. Langworthy, O. R., and Tauber, E. S.: The Control of the Pupillary Reaction by the Central Nervous System, J. Nerv. & Ment. Dis. **86**:462, 1937.

In this case, then, I saw the Argyll Robertson pupil develop and I saw it disappear; I watched this transformation for at least five times. Cases such as this show that one cannot be certain that this phenomenon is purely syphilitic, as it has been described. It is usually syphilitic in origin. Such a pupil must always make one think of syphilis, but it has been described by good observers as occurring even in traumatic conditions affecting the mesencephalon.

There is certainly a physiologic differential in the pathways of the visual functions and the pupillomotor fibers. It is probable that the pupillomotor fibers pass from the superior colliculi subependymally in the gray matter of the aqueduct, just below the gray matter of the aqueduct, toward the third nucleus, and it is quite probable that they never reach the third nucleus. They probably go below the third nucleus and pass, with the fibers coming from the third nucleus, to the ciliary ganglion. It has been commonly said that the tonic pupils we spoke of are due to a lesion of the ciliary ganglion, but this is simply because of an unthoughtful acceptance of the old theory that the Argyll Robertson pupil was due to a lesion of this ganglion. The ciliary ganglion is normal in the vast majority of cases of tabes. I think that it is occasionally abnormal as a secondary result of the destruction of these pupillomotor fibers in the subependyma producing a secondary degeneration of the ciliary ganglion. The main lesion is almost certainly located in the neighborhood of the floor of the aqueduct. Why does this cause the knee jerks to disappear? What has it to do with the knee jerks? It is not known for sure, but certain tonic centers do exist in the periaqueductal area; the area for general muscle tonus is influenced by centers in the neighborhood of the floor of the aqueduct, the exact nature of which is not understood, though lesions here are often associated with complete disappearance of deep reflexes from altered tonus. It is common in cases of midline tumor of the cerebellum, in which the aqueduct is enormously dilated and in which the ependyma of the aqueduct is under compression, to find that the knee jerks have disappeared. Why this phenomenon should be associated with abnormal emotional states, as it seems to be, is again speculative. Of course, if a person in whom this sign is present did not have something the matter with him he would not see a physician. And when he does, it is probably easy for the physician to associate his complaints (and most complaints are emotional, after all) with the peculiar anatomic condition which is found. On the other hand, the hypothalamus is the governing center for one's emotional make-up. Changes in the hypothalamus can make a pessimist out of an optimist or an optimist out of a pessimist, and it is perfectly possible that tense emotions will interfere with proper conduction of fibers! That reminds me of a conversation I had once with Michael Pupin, who asked me if doctors had found the place in the brain that governs emotion, and to his surprise I said "yes." He said, "That is very interesting; where is it?" So I answered, "In the hypothalamus." "Ah," he said, "I did not know that, but can you pull the switch?" I said, "No, we cannot pull the switch yet, but when we can all the governments of the earth will arrange for a great switching day at the switching posts, and everybody will be willing to be switched into happiness. There will be one man in every two hundred

million who will hang back, and six months after the switching day those men who would not be switched into contentment will find that they are lords of the world; and six months after they have become lords of the world, they will find that there is no world to become lords of, that they are merely shepherds of sheep. Nobody will work, so the lords of the world, in order to make humanity unhappy and miserable and therefore ambitious and ready to work, will gather up all the doctors, load them onto scows and tow them into the Atlantic Ocean and sink them! So, if the medical profession found out too much about the hypothalamus, and if it really found out why persons with a lesion in this region have no reflexes, it might risk destroying itself, and therefore it has taken care to fail."

DR. JOHN H. DUNNINGTON: I am sure that the syndrome reported has been overlooked many times. The point which seems to me to be of particular value, and which possibly has not been stressed enough, is the ease with which the pupils of a person with this condition dilate with the use of a mydriatic. I have found this sign to be of help in arriving at a diagnosis. Also, the fact that they dilate after long exposure in a dark room and contract slowly is another point.

DR. JOHN H. BAILEY: About three months ago I had occasion to observe two patients, a brother and sister, with a typical pseudo-Argyll Robertson pupil, and I was rather intrigued when I looked up the literature on the subject. I do not wish to detract any credit from Adie; but in 1921 Behr elaborately described pupillotonia, and I feel therefore that this condition might be called the Behr-Adie syndrome rather than the Adie syndrome. Adie's paper appeared in 1931, and Behr's very clarifying article appeared in 1921, ten years previously. I think that one often misses this syndrome because one is not sufficiently persistent in making examinations. The pupil will not react to light apparently, but if Behr's technic is carried out and the patient is placed in a dark room for about an hour there will be a slight dilatation of the pupil. However, when the patient is suddenly exposed to bright daylight, there will be a moderate contraction of the pupil; then the pupil will contract a little more and, finally, it will resume its former size, but this reaction is by no means so extensive as the convergence reaction. It is this reaction which gives the syndrome its name—it is a tonic reaction to convergence. At times it will take as much as five minutes before this reaction to convergence will appear. Most examiners do not have sufficient patience to wait that long. If the patient does not show a reaction in a minute or two, the examiner ceases to look for it, but if he would wait five minutes, a typical convergence tonic reaction would be observed. In distinguishing between the Argyll Robertson pupil and the pupillotonic condition, it is necessary to bear in mind that the psychosensory reflex is retained in pupillotonia while in the Argyll Robertson pupil it is absent. Just as there is a spasmodic contraction of the sphincter iridis on convergence, there may be a spasmodic contraction of the ciliary muscle, so that when a patient looks at a distant object everything looks blurred because there is a spasm of accommodation. When the patient squeezes the eyelids or tries to close them against resistance, there will be a contraction of the

pupil, the Westphal-Piltz reflex. In pupillotonia there may be a sustained contraction of the pupil, while in the presence of an Argyll Robertson pupil this reflex offers nothing unusual.

DR. ERNST WALDSTEIN: I think that in the great majority of cases reported by Adie the characteristic tonic pupil was limited to one side, the other pupil being normal. I noticed also that in most of the cases reported by Dr. Kennedy and his associates there was a unilateral pathologic pupil. This unilaterality, therefore, seems to be a convenient characteristic of Adie's disease, in contradistinction to the classic Argyll Robertson symptom.

DR. HERMAN WORTIS: I think that we can agree with Dr. Dunnington.

Regarding our use of the term "Adie's syndrome," we agree that Behr described this condition before Adie, but, as we have already pointed out, Saenger and Strasburger described typical cases before both of them, and it is not unlikely that some historically minded colleague, on searching the literature, will find that the inevitable Hippocrates antedated them both. We used the term "Adie's syndrome" because it has apparently been accepted in the literature.

The apparent lack of reaction to light in these cases cannot be stressed too much. The pupils apparently do not react to light, but if the patient is placed in a dark room a slight reaction to light is usually obtainable. The fact that the pupils of such persons do react to convergence is probably the result of many factors, not the least of which is that convergence is a much stronger stimulus. As a matter of fact, the entire pathophysiology of pupillary reactions is still a matter of much debate. The peripheral autonomic control of the pupil is too well known to bear repetition here. With regard to the central control of pupillary reactions, little is known. There is, however, much evidence to indicate that there is a reflex arc which, passing through the hypothalamus, controls the sympathetic innervation of the pupil. There is also evidence that the cerebral cortex exerts a control over pupillary reaction, largely through the parasympathetic pathways. These findings, however, are still in the experimental stage, and until more definite knowledge is obtained they are probably best not applied to clinical problems.

Dr. Bailey also mentioned the spasmodic contraction of the sphincter iridis in one of his cases. This was also true in case 1 of our series, in which it took one hundred and twenty seconds for the pupil to reach its peak dilatation after contraction.

The problem of unilaterality is difficult to answer. In the cases reported by R. Foster Moore, the left pupil was usually affected. This brings up the entire problem of cerebral dominance, which Dr. Kennedy has stressed so much in his neurologic teachings. It is known that the left side of the brain is usually dominant in right-handed persons, but to go from there through the hypothalamic nuclei and back to the pupil takes one into the realm of speculative pathology—a realm we are anxious to avoid.

PNEUMOCOCCIC BACTERIOPHAGE

ITS APPLICATION IN THE TREATMENT OF ULCUS CORNEAE SERPENS

A. M. RODIGINA, M.D.
PERM, U. S. S. R.

Bacteriophagy was discovered by the French scientist D'Herelle in 1917.

According to D'Herelle's view of the bacteriophage as a living body, its main features are as follows: (1) It is capable of bringing about profound changes in the microbial cell leading to its entire dissolution; (2) it is capable of propagation while affecting bacteria and (3) it can exert its action in the presence of a living cell.

D'Herelle's phenomenon is detected by microscopic examination of cultures on nutritive mediums.

On fluid mediums bacteriologic cultures become clear in eight hours after inoculation in the presence of a phage.

On solid nutritive mediums the bacteriophage is detected by the formation of so-called sterile spots (*taches vierges*), or "negative" colonies. For this purpose the tested filtrate and the culture are mixed and then inoculated in agar cups at various intervals. In from eighteen to twenty-four hours at 37 C. either incomplete growth results, i. e., free spaces are seen (*taches vierges*) between the colonies in the cups or no growth is obtained.

The microscopic picture shows what profound alterations take place in the bacterial cell previous to its entire dissolution.

The activity of the bacteriophage increases with each succeeding inoculation and can be determined by titration.

Against the pneumococcus, which is of much importance in diseases of the eye, no bacteriophage has been discovered previous to the findings reported here.

The bacteriophage has acquired a double importance in medicine: as a prophylactic and as a remedy.

The experiments with phagoprophylaxis and phagotherapy in typhus (typhoid), dysentery, paratyphus and other gastric infections in man (reported by D'Herelle, Handuroy, Eliava, Melnik, Khastovich,

From the Ophthalmological Clinic of the Perm Medical Institute, Prof. P. I. Chistyakov, Director.

Burstein and others) led to the conclusion that in the future it will be necessary to increase the application of the bacteriophage, especially in bacillary dysentery, since bacteriophagotherapy, provided certain obligatory moments are observed, unquestionably lessens mortality and accelerates recovery.

In ophthalmology the bacteriophage is so far little known. I succeeded in finding in the literature, chiefly the foreign literature, several reports of work along this line, partly experimental and partly clinical. Demme, Giano Piero, Collevati, Max Strumio, Hunter Scarlett, Thibairenq, Town and Frisbee are the few authors who have studied the bacteriophage in relation to ophthalmology.

Prof. P. I. Chistyakov suggested that I devote my studies to isolation of the pneumococcic bacteriophage and, if I succeeded in isolating it, to its application as a remedy for pneumococcic diseases of the eye, chiefly for serpigenous ulcer of the cornea.

In the available literature are hints of several ineffective attempts to obtain the pneumococcic bacteriophage. I refer to the works by Brainard and Noble, Eddy, and Balsamelli.

EXPERIMENTS IN ISOLATION OF THE PNEUMOPHAGE

At the beginning of my work I availed myself only of ophthalmic material. The bacterial flora of material from serpigenous ulcers of the cornea was tested, and the pneumococcus, if present, was isolated from other micro-organisms.

Then the pneumococcic culture, after being verified, was inoculated in serum bouillon and in from eighteen to twenty-four hours was passed through a Berkefeld filter.

The filtrate, after being tested for sterility, was tested for its lytic effect. But I failed in all my attempts to obtain the bacteriophage from pneumococcic cultures. I managed to discover the cause of my failure later when working at the Leningrad Pasteur Institute.

Special methods are required to obtain the bacteriophage phenomenon, since it was established by D'Herelle's observations that the bacteriophage is not always present in material from a diseased organism; it cannot be revealed whenever one chooses to determine its presence, but its appearance coincides with a definite state of the organism, namely, the period of recovery.

Consequently in order to secure the bacteriophage it was necessary to study material systematically, at times perhaps for rather long periods. Regrettably, this principle cannot be applied to the material obtained from the cornea affected with serpiginous ulcer.

It was necessary to obtain initial material from some other source. The vicinity of the therapeutic clinic of the Perm Medical Institute

enabled me to set about systematic daily investigation of the sputum of persons with pneumonia.

The isolation of the pneumococcic bacteriophage was carried on by a common method.

I made mass inoculations of sputum on fluid and solid nutritive mediums, sometimes no less than from ten to twelve sputums being studied daily. In twenty-four hours, bouillon cultures, after being tested bacterioscopically, were filtrated. Filters failing, I made use of hand-made filters of talc, according to a description given by Borisov and Osher in *Laboratory Practice,* 1934. A model of the filter is shown in figure 1.

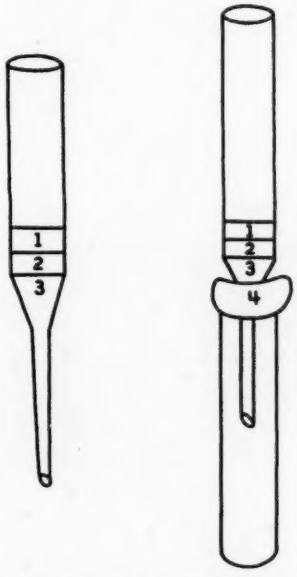


Fig. 1.—Model of hand-made filter used in separating the pneumophage. *1* and *3* are spaces containing cotton; *2* is the space containing talc, and *4* is the cork of cotton.

By means of these methods I succeeded in isolating the first pneumophage in March 1935.

The presence of the bacteriophage was evidenced by complete transparency of the bouillon culture, which set in after from twelve to eighteen hours in a test tube. On solid nutritive mediums the presence of the phage was often revealed in the form of spaces free from cultures (*taches vierges*) and in fanciful forms (fig. 2).

The action of the pneumophage was established by the amount necessary to destroy a definite quantity of bacterial suspension. The bacte-

riophage tested was added in decreasing quantities (1.0, 0.5, 0.3, 0.1, 0.05, 0.03, 0.01, and 0.005 cc.) to the bouillon inoculated with one drop of a bouillon culture 24 hours old. The least quantity of the phage which could produce complete transparency of the culture was indicative of the strength of the bacteriophage.

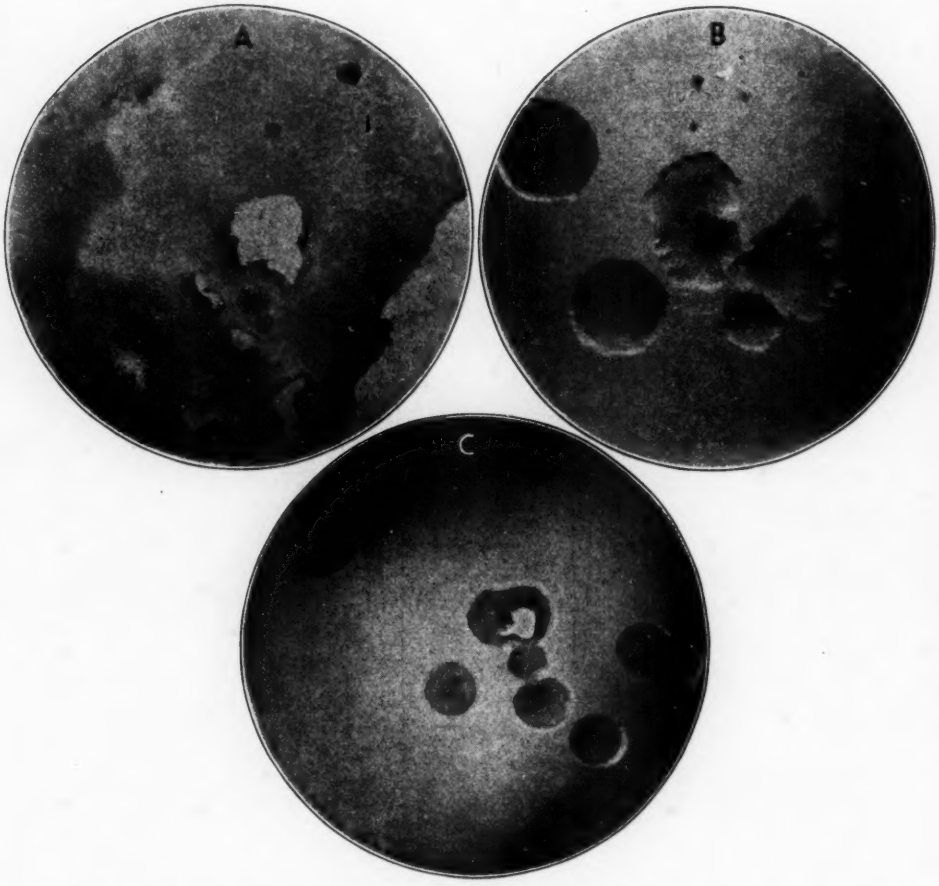


Fig. 2.—*A*, pneumococcic culture showing *taches vierges; B* and *C*, pneumococcic culture showing fanciful forms.

Spontaneous lysis, which occurs not infrequently in old museum cultures, took place in these experiments, but this has nothing in common with the lysis caused by the true bacteriophage (Brainard and Noble).

From the table it is clear that the pneumophage obtained from various pneumococcic cultures caused the dissolution of pneumococcic

cultures of any type, but not of all cultures to the last. In these experiments, as in many others, three kinds of pneumococcic cultures were distinguished, differently relating to the pneumophage independently of their type: (1) lysosensitive strains, (2) strains capable of changing from lysoresistant to lysosensitive ones if the phage is in action and (3) lysoresistant strains not in the least affected by the bacteriophage. Each of these groups contains representatives of all types of pneumococci, and consequently there is no basis for speaking of the strict type specificity of the pneumophage. It was found that the pneumophage can be obtained from pneumococcic cultures of every type and that such a pneumophage not only acts inside the initial cultures of its type but spreads its lytic action also outside of the typical realm of the pneumococcus.

The extent of the lytic energy is not closely connected with the type of pneumococcus, as I have obtained a very active pneumophage with a high indicator of action from cultures of pneumococcus type X. This bacteriophage was no less strong than that obtained in the virulent culture of pneumococcus type I, but the available data suggest that the pneumococcic phage obtained from cultures of pneumococcus type III is weaker than those obtained from cultures of other types of pneumococcus.

On the other hand, cultures of pneumococcus type III are known to be more resistant against the bacteriophagic lysin than cultures of any of the other types of pneumococcus. The table also shows the essential property of the pneumophage—its increase in lytic power in a test tube. If at the beginning of the experiment lysis of a pneumococcic culture required 0.3 cc. of the pneumophage, later on this quantity became reduced by degrees and finally amounted to such minimum values as from 0.01 to 0.005 cc.

Summarizing the data in the literature and the results of my own investigations, I am led to the following conclusions:

1. The role of the bacteriophage phenomenon in both therapeutic and prophylactic medicine is now completely proved; in ophthalmology, however, this problem has practically not been broached.

2. Notwithstanding many attempts to isolate the pneumophage, this has not been accomplished heretofore.

3. I was the first to succeed in isolating the pneumococcic phage, which fully meets the requirements for a true bacteriophage in the following respects: (*a*) it is capable of producing changes in the pneumococcic culture, beginning with the production of fanciful colonies *(Flatterformen)*, mucous groups and sterile regions *(taches vierges)* and ending in complete lysis of pneumococcic cultures. (*b*) It can be gradually intensified by means of a series of procedures. (*c*) It can

exist only with the pneumococcic culture; if isolated, it quickly renders the pneumococcus inactive.

4. The process of isolating the pneumophage calls for definite methods. It is necessary systematically to study the material in which the pneumococcus is contained.

Ratio of Bacteriophages to Different

Type of Pneumococcus	Pneumococcic Cultures	Amount of Culture	Tested Pneumophages: Belyayeva				Orlova				Bogdanova			Godshivalova		
			Dates of Observation: 3/7	3/11	3/15	3/30	2/21	3/1	3/9	3/12	3/9	3/12	3/20	3/24	3/28	3/28
			Amount of Bacteriophage, Cc.: 0.5	0.5	0.25	0.1	0.5	0.25	0.1	0.05	0.5	0.5	0.25	0.05	0.01	0.005
IV	Novinskaya	In all experiments 1 drop of nondiluted bouillon culture of pneumococcus	—	+	+	+	+	+	+	+	+	+	+	+	+	+
IV	Orlova		—	+	+	+	+	+	+	+	—	—	+	+	+	+
III	Khokhlova		—	—	—	—	+	+	+	+	—	+	+	—	—	—
III	Fedotova		+	+	+	+	+	+	+	+	—	—	—	—	—	—
II	Belyayeva		+	+	+	+	∓	—	—	∓	—	+	+	+	+	+
II	Bogdanova		+	+	+	+	∓	+	+	—	+	+	—	—	+	+
I	Mingaleyeva		—	+	+	+	..	..	..	..	+	+	+	+	+	∓
I	Malkova		—	—	—	—	+	+	+	+	+	+	+	+	+	+
I	Kafakova		—	—	—	—	..	..	..	..	..	..	..	..	..	..
I	Varova		—	—	—	+	+	+	+	+	—	—	—	—	—	—
II	Nechayeva		—	—	+	+	—	—	—	—	—	—	—	—	—	—
IV	Permyakova		—	∓	∓	+	—	—	—	—	—	—	—	—	—	—
IV	Labdeyeva		—	—	—	+	..	..	..	..	—	—	—	—	—	—
I	Lychova		—	—	—	+	..	..	..	..	..	..	..	..	..	..
I	Suryanova		—	—	—	+	..	..	..	..	..	..	..	..	..	..
IV	Zolotukhina		—	+	+	+	+	+	+	+	—	—	+	+	+	+
III	Chazova		..	..	..	..	..	..	..	..	..	..	..	..	..	..
I	Rubtsova		..	..	..	..	..	..	..	..	..	..	..	..	..	..
II	Lahhvatkina		..	..	..	..	..	..	..	..	..	..	..	..	..	..
I	Podshivalova		..	..	..	..	..	..	..	..	..	..	..	..	..	..
II	Yermakova		..	..	..	..	..	..	..	..	..	..	..	..	..	..
II	Nyetsvetayeva		..	..	..	..	..	..	..	..	..	..	..	..	..	..
IV	Chirkova		..	..	..	..	..	..	..	..	..	..	..	..	..	..
III	Boney		..	..	..	..	..	..	..	..	..	..	..	..	..	..
II	Mezentseva		..	..	..	..	..	..	..	..	..	..	..	..	..	..
IV	Karpova		..	..	..	..	..	..	..	..	..	..	..	..	..	..
III	Medvedyeva		..	..	..	..	..	..	..	..	..	..	..	..	..	..

5. The time of appearance of the pneumophage in a person with pneumonia always coincides with the period of convalescence; namely, it appears in the sputum after the crisis.

6. I also succeeded sporadically in isolating the pneumophage from sputum of persons with ocular disease and pneumonia.

7. No differences in the properties of the pneumophage of pulmonary origin and those of the pneumophage of ocular origin were recorded.

EXPERIMENTS IN TREATMENT OF ULCUS CORNEAE SERPENS WITH THE PNEUMOPHAGE

When setting about the work of applying the pneumophage as a remedy for serpiginous ulcer of the cornea I wondered whether any new remedies were required for this condition. I discovered an ample

Strains of Pneumococcic Cultures

Tested Pneumophages																		
Yermakova				Karpova				Suryanova										
Dates of Observation																		
3/26	3/31	4/20	4/25	9/6	9/8	9/12	9/12	9/9	9/13	9/13	9/18	11/9	11/12	11/12	11/12	11/16	11/16	11/16	Control Cultures
Amount of Bacteriophage, Cc.																		
0.5	0.1	0.1	0.01	0.5	0.5	0.1	0.05	0.5	0.5	0.25	0.25	0.5	0.5	0.25	0.1	0.1	0.05	0.01	
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
−	+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
∓	−	−	−	..	..	..	..	−	−	−	−	−	−	−	−	−	−	−	−
−	−	−	−	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
+	+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
∓	∓	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
+	+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
+	+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
+	+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
+	+	−	−	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
+	+	+	−	−	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	−	+	+	−	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	−	−	−	−	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	−	+	+	−	..	..	..	..	..	..	..	..	..	..	..	−
..	..	..	..	+	+	+	+	−	+	+	+	..	..	..	..	..	..	..	−
..	..	..	..	+	+	+	+	−	∓	+	+	+	+	+	+	+	+	+	−
..	..	..	..	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	−
..	..	..	..	−	−	−	−	−	+	+	+	+	+	+	+	+	+	+	−
..	..	..	..	−	−	−	−	+	+	+	+	+	+	+	+	+	+	+	−
..	..	..	..	..	..	..	..	+	+	+	+	+	+	+	+	+	+	+	−
..	..	..	..	..	..	..	..	−	−	−	−	−	−	−	−	−	−	−	−
..	..	..	..	..	..	..	..	+	−	+	∓	+	+	+	+	+	+	−	−

supply of all kinds of treatment suggested by different writers for this purpose.

After studying the literature I became convinced that, notwithstanding the number and diversity of ways of treating ulcus corneae serpens, the practicing ophthalmologist has no reliable remedy, and that some new method of treatment is needed.

In contradistinction to pharmaceutic, physicochemical and surgical methods of treating ulcus corneae serpens, which produce great destruc-

tion of the sound tissue of the cornea, biologic methods may be tried, which are based on the immunization phenomenon. Beautifully worked out in theory, they have not, however, been borne out in practice.

The structural peculiarities of the cornea—its density and the absence of blood vessels—seem to exclude any hope for success in general immunization. Serotherapy, which was ardently advocated at one time by Römer, has not quite found its application in the treatment of serpiginous ulcer, for which it was chiefly suggested by that author.

It would be more reasonable to make use of local immunization of ocular tissues for treating pneumococcic ulcer of the cornea by the application of the active virus after the method of Bezredka. The main point to be taken into account in effective treatment with this method, viz., the possibility of the closest contact of the morbid region with the immunizing agent, in this case with the active virus, can be secured to the highest degree in cases of ulcus corneae serpens. Regrettably, no literature relating to the question exists.

Treatment of corneal diseases by the bacteriophage appears to meet this demand still more successfully. The main property of the bacteriophage—production of lysis of the bacterial culture—may be made use of on the very spot and in the very region affected. The effect of applying the bacteriophage will be still greater than it would be if applied elsewhere, since it will exert a strictly specific influence on the respective culture. The third favorable aspect is the complete innocuousness of the bacteriophage to the tissue of the cornea.

At first I tried to verify and study the effect of the pneumophage on the eyes of animals. For this purpose I carried out experiments on sixteen rabbits, inoculating the pneumococcus into the cornea and inducing ulcus corneae serpens. With a view to infecting the cornea, I utilized virulent strains of different types of the pneumococcus, having isolated them mostly from the sputum of persons with pneumonia. I applied as treatment either the monophage, which produced lysis of a given pneumococcic culture in a test tube, or the polyphage, composed of several strains of the pneumococcic bacteriophage.

A description of the methods and results in these experiments follows. In the series of experiments the methods applied were the same as were the time of beginning the treatment with the bacteriophage, the duration of observation, the time of enucleation of the eye and other factors.

On the fourth or fifth day after the inoculation all the rabbits showed ulcus corneae. Growing superficially and in depth from day to day, the process acquired an appearance typical of ulcus corneae serpens. Apart from infiltration and extension of the ulcer at its margin, pus appeared in the anterior chamber of the eyes of many of the rabbits. The culmination of the ulcerous process was reached on the seventh day.

From this day on I began treating some of the rabbits, i. e., eleven, with the pneumophage; the rest (the control animals) were not treated.

From the results of the experiments on the rabbits' eyes with induced ulcus corneae serpens the following conclusions may be drawn:

1. The results obtained by me with the pneumophage in eyes with ulcus corneae serpens open broad views in ophthalmology and permit me to call ophthalmologists' attention to this new remedy.

2. The pneumophage exerts an obvious curative action, quickly stopping the ulcerous process and preventing the destruction of corneal tissue. Eventually the ulcer in the eyes of the animals that were treated by the pneumophage was represented by a small, limited dim area of the cornea.

3. In the eyes of the control animals the ulcerous process of the cornea took a painful course and ended in atrophy of the eyeball in one case and in the development of a large coalescent wall eye in another.

My clinical observations on the results of application of the pneumophage for the treatment of ulcus corneae serpens are so far scanty, and the study has not advanced beyond the stage of collection of clinical material.

No final conclusions are offered at this stage of the work, but the first impressions obtained are rather encouraging. Every ophthalmologist knows that it is hard to treat ulcus corneae serpens, and that all the present remedies, even the most heroic ones, remain ineffective. That is why I call the attention of scientists to this new way of treating ulcus serpens.

ABNORMAL ARTERIOVENOUS COMMUNICATION IN THE ORBIT INVOLVING THE ANGULAR VEIN

REPORT OF A CASE

THEODORE L. TERRY, M.D.
AND
GUSTAVE B. FRED, M.D.
BOSTON

An abnormal arteriovenous communication involving the angular vein is apparently an extremely rare occurrence, since, so far as we have been able to ascertain, no such involvement has hitherto been reported. The rarity of the condition, as well as the unusual features of postoperative convalescence, justifies this report.

REPORT OF CASE

History.—An Italian woman 23 years of age in the eighth month of pregnancy noticed exophthalmos of the left eye. Within three days the swelling reached its maximum. The patient noticed no pain or alteration of vision. She did, however, hear a peculiar sound in her head and felt a pulsation in the region of the left eye at night after she retired, but she was unable to describe the character and quality of the sound. She accepted this condition as a part of the discomfort incident to the late stages of pregnancy, although she had not experienced this with her four previous pregnancies, one of which terminated in miscarriage. Although the patient was vague about all the details of the history, she was sure that she had never sustained any direct or indirect trauma to the region of the left eye or to the head in general.

Nine weeks after the onset of the exophthalmos (two weeks after parturition) the patient came to the Massachusetts Eye and Ear Infirmary for diagnosis and treatment of the exophthalmos.

Examination.—The left eye was 7 mm. farther forward than the right eye, as determined by the Hertel exophthalmometer. It appeared to be pushed straight forward. Some limitation of motion was present in looking up and to the left. There was no pulsation of the eye. The exophthalmos could be reduced considerably by pressure on the lids.

The presence of considerable edema of the nasal bulbar conjunctiva and swelling of the tissues of the nasal third of the lids accentuated the appearance of exophthalmos. The upper lid showed more swelling than the lower. There was also considerable swelling over the tear sac. The skin over the swelling and the chemotic conjunctiva was only moderately hyperemic. The tumor also could be partially reduced by pressure. An intermittent thrill was easily felt, the inter-

---

From the Massachusetts Eye and Ear Infirmary.

missions being synchronous with the pulse in the temporal artery. The rate of the intermissions of the thrill seemed synchronous with the arterial pulse. On auscultation a loud, blowing, continuous murmur was heard. It was loudest over the angular vein, just above the inner canthus. It could not be heard over the temporal region or in the neck. Although the murmur was continuous, its volume and character changed in synchronism with the arterial pulsation. Firm compression of the left internal carotid artery reduced the volume and character of the murmur and caused the palpable thrill to cease. Pressure on the angular vein well below the tumor produced similar results, although the change in the murmur was less striking.

Vision was 20/40 in each eye. The retinal veins of the left eye were engorged.

The left preauricular lymph node was somewhat enlarged and easily palpable.

The Hinton test of the blood was negative.

An x-ray film of the skull showed a shadow in the left antrum. On the basis of this a cyst of the left antrum was found and drained. Clear serous fluid was obtained from the cyst.

A diagnosis of an abnormal arteriovenous communication was made. Because the murmur was limited definitely to the region of the left orbit, it was thought that the aneurysm was neither in contact with the eye nor behind the equator of the globe.

On the basis of these opinions an exploratory operation was decided on.

Operation.—With the patient under ether anesthesia, exploration was made for an aneurysm at the inner angle of the left orbit.

The incision, similar to that commonly used in external ethmoidectomy, was made on the nose. Immediately under the subcutaneous tissue a large, tortuous angular vein was found. It was some 10 mm. in diameter. Further dissection revealed that it rapidly became narrow, approximating the normal size at about the lower end of the nasal bones. Its tributaries became normal in size at the supra-orbital ridge. Branches from the nose dilated just before they entered the vein. At the level of the inner canthus, whirls and eddies of arterial blood could be seen entering the vein. Each tributary of the enlarged vein was tied near the point of entrance. The angular vein was tied where it became more nearly normal in size. The dilated vein was then cut away from its attachments. At the level of the inner canthus, where the whirls and eddies were seen, a small artery was found to be entering on the deep surface of the vein. The artery was thought to be the infratrochlear branch of the ophthalmic artery. It was tied and cut. The enlarged vein was removed. A sterilized stethoscope was then applied, and the murmur was found to have ceased. The thrill could not be felt. The orbital tissues were dissected from the medial wall and the anterior ethmoidal vessels and nerves located. The vein seemed to be dilated. These vessels were tied off but not cut. At the end of the operation the swelling of the lid and the exophthalmos increased. The incision was closed tightly with sutures. To keep the lids closed it was necessary to suture them together. A mattress stitch was taken with no. 6 black silk. A pressure bandage was applied, and the patient was returned to the ward in good condition.

Postoperative Course.—Some eight hours later the exophthalmos had increased materially. Edema of the conjunctiva had increased to such an extent that the conjunctiva partially protruded between the lids in spite of the suture in the lid.

Three days after the operation the proptosis and edema were so great that the sutures in the lid broke down. The cornea would have been exposed had the edematous bulbar conjunctiva not protected it. The congestion of the retinal

veins had increased considerably, and papilledema of 2 D. was present. The portion of the retina temporal to the disk in the region of the macula was edematous.

The temperature of the lids of each eye was taken by inserting a clinical thermometer into the conjunctival sac. The temperature on the left was 1 degree higher than that on the right.

The increase in the exophthalmos and in the edematous swelling of the lids and conjunctiva was so marked that necrosis of the lids and conjunctiva seemed imminent. The eye was immobile. Sutures were run through the edematous conjunctiva in the hope that some of the fluid would run out along them. There was some drainage, but not sufficient to reduce the edema appreciably. Neither compresses soaked in hypertonic solution of magnesium sulfate nor the application of a pressure bandage had any apparent effect in reducing the edema. After temporizing some eight days with these measures there was a slight but definite reduction in the edema of the lids, accompanied by a slight return of motility to the eye.

After the use of the pressure bandage some wrinkles of the cornea or corneal infiltrates were observed. The intra-ocular pressure was elevated to 35 mm. (Schiötz). As the condition was unrelieved by a miotic, paracentesis was done. Increase in tension did not recur. It is interesting to note that glaucoma and papilledema were simultaneously present. After the use of the miotic, progress of the papilledema could not be observed.

Twenty-four days after the original operation the reduction in the edema and in the exophthalmos was sufficient to permit resuturing of the lids after external canthotomy. A sufficient gap was left between the sutures to permit observation of the cornea, measurement of the ocular tension by means of the Souter tonometer and the administration of miotics. After operation the edema of the conjunctiva abated more rapidly. When the sutures were removed five days after their introduction, only a small amount of edematous conjunctiva projected through the lids in the region of the caruncle.

Reduction of the exophthalmos gradually continued, as did the papilledema and the edema of the conjunctiva and lids. The motility of the left eye gradually returned to normal. Some seven months after operation the only apparent deformity was the operative scar and a white scar in the macula. The left visual field was concentrically contracted some 30 degrees, and the left blindspot was twice the normal size. Visual acuity was 20/50.

COMMENT

The spontaneous appearance of an abnormal arteriovenous communication in the latter part of pregnancy in a multipara must have been due to some congenital defect in the vascular bed. The fact that the communication was directly from the artery to the vein indicates that its origin was probably not through the medium of an angioma. A lack of sufficient musculature in the arterial wall may have produced a simple aneurysm,[1] which may have ruptured into the vein later. Vestigial remains of prenatal communications between vessels destined

1. Forbus, W. D.: On the Origin of Miliary Aneurysms of the Superficial Cerebral Arteries, Bull. Johns Hopkins Hosp. **47**:239 (Nov.) 1930.

to become an artery and a vein [2] can reopen. The changes in the circulation incident to the pregnancy may have had a definite contributory effect, but why this should not have occurred in a pregnancy earlier than the fourth is not obvious. Other than the one miscarriage and the aneurysm, there was no evidence suggestive of syphilis.

The increase in the exophthalmos and in the edema of the lids immediately after the removal of the vein and the abnormal arteriovenous communication, as well as the increase in the temperature of the left lid, is consistent with changes in other parts of the body after removal of an abnormal arteriovenous communication. Reed [3] has shown that there is an increase in the caliber and tortuosity of vessels, as well as an actual increase in the number of capillaries, in the region of arteriovenous aneurysms. These vessels have been accustomed to a very sluggish circulation, due to the marked elevation in the venous pressure and some reduction in the arterial pressure. Sudden restoration of more or less normal arterial and venous pressures to the area improved the circulation through the dilated, tortuous vessel and the increased capillary bed sufficiently to increase the edema and elevate the temperature. The orbit seems more prone to edema than most other tissues of the body, owing to a possible difference in the lymphatic drainage.

If a period of time had been allowed to elapse before the aneurysm was removed, possibly a better collateral circulation would have been provided, due to the arteriovenous communication itself.[4]

One of us (G. B. F.) felt that had only the arterial communication to the vein been tied at the original operation and the venous return not been severed, the resultant proptosis and edema might not have occurred. Obliteration of the communication between an artery and a vein is not conducive to permanent relief, the communication usually reestablishing itself, according to many observers. On a somewhat different basis, tying of the left carotid artery was considered during convalescence (G. B. F.).

---

2. Smith, Ferris: Congenital Arteriovenous Fistula in Tympanum, Arch. Otolaryng. **10**:32 (July) 1929.

3. Reed, M. R.: Studies on Abnormal Arteriovenous Communications, Acquired and Congenital: Report of Series of Cases, Arch. Surg. **10**:601 (March) 1925; Abnormal Arteriovenous Communications, Acquired and Congenital: Origin and Nature of Arteriovenous Aneurysms, ibid. **10**:996 (May) 1925; Abnormal Arteriovenous Communications, Acquired and Congenital: Effects of Abnormal Arteriovenous Communications, ibid. **11**:25 (July) 1925; Abnormal Arteriovenous Communications, Acquired and Congenital: Treatment of Abnormal Arteriovenous Communications, ibid. **11**:237 (Aug.) 1925; Am. J. Surg. **14**:17 (Oct.) 1931.

4. Koster, W.: Beiträge zur Lehre von Glaukom, Arch. f. Ophth. **41**:30, 1895.

The glaucoma was probably due to back pressure in the vortex veins, due to the marked increase in the orbital pressure. Temporary glaucoma has been produced in laboratory animals by blockage of vortex veins.[4]

Papilledema occurs with increased orbital pressure and in itself is not surprising.

The reduction of the visual field can be explained better on the basis of prolonged papilledema than as due to the glaucoma, since the defect in the field was not typical of glaucoma, and the glaucoma was of short duration. Loss of macular vision was due to injury of the macula, resulting in the scar already mentioned.

SUMMARY AND CONCLUSIONS

A spontaneous arteriovenous aneurysm between the angular vein and the infratrochlear branch of the ophthalmic artery was cured by removal.

The resultant exophthalmos, increased temperature and papilledema were probably due to sudden restoration of a relatively normal circulation to a vascular bed accustomed to abnormal, sluggish circulation.

The glaucoma was probably due to closure of vortex veins by passive congestion or by increased orbital pressure.

DIPLOCOCCUS PNEUMONIAE AND STREPTOCOCCUS VIRIDANS IN OCULAR DISEASES

REPORT OF ONE HUNDRED CASES

E. W. NEWMAN, M.D.
CHEYENNE, WYO.

Diplococcus pneumoniae was classified as types I, II and III and group IV prior to 1929, when Cooper [1] and her co-workers separated group IV into twenty-nine additional types. At the present time the recognized types are designated by the Roman numerals I to XXXII, inclusive. A number of important studies of the pneumococcus in ocular diseases have appeared in the literature, but a study of the types included in group IV has not been reported. Römer [2] unsuccessfully attempted to treat ulcus serpens corneae with antiserums, but, since approximately 75 per cent of the pneumococci which cause ophthalmic disease are group IV organisms, specific serum reactions were not to be expected. Consequently, it appeared practical to undertake an investigation of the organisms in this heterogenous group.

In 1917 Avery and his co-workers [3] studied the relative incidence and mortality for the four original types of pneumococci in pneumonia (table 1). They established types I, II and III as the etiologic agents in 76 per cent of the cases of pneumonia, while group IV, although most commonly found in the oral secretions of normal persons, was responsible for the condition in only 24 per cent. Since that time many investigations concerning the pneumococcus, including group IV, have

From the Department of Ophthalmology, College of Medicine, State University of Iowa.

1. Cooper, G.; Edwards, M., and Rosenstein, C.: The Separation of Types Among the Pneumococci Hitherto Called Group IV and the Development of Therapeutic Antiserums for These Types, J. Exper. Med. **49**:461-474 (March) 1929. Cooper, G.; Rosenstein, C.; Walter, A., and Peizer, L.: The Further Separation of Types Among the Pneumococci Hitherto Included in Group IV and the Development of Therapeutic Antisera for These Types, ibid. **55**:531-554 (April) 1932.

2. Römer, P.: Experimentelle Grundlagen für klinische Versuche einer Serumtherapie des Ulcus corneae serpens nach Untersuchungen über Pneumokokkenimmunität, Arch. f. Ophth. **54**:99-200 (April) 1902.

3. Avery, O. T.; Chickering, H. T.; Cole, R., and Dochez, A. R.: Acute Lobar Pneumonia: Prevention and Serum Treatment, Monograph 7, Rockefeller Institute for Medical Research, 1917.

been made; these studies have shown that the incidence of the types and their virulence, complications and other aspects vary with the season, year, locality and age group affected. In general, the more acute pneumococcic infections are due to type I, II or III, while the less acute or atypical conditions are caused by some organism of group IV.

Gundel,[4] in a study of 3,000 normal persons, found that of the pneumococci in the upper respiratory tract, from 1 to 4 per cent were types I and II, that approximately 10 per cent were type III and that at least from 50 to 60 per cent were of group IV. He noted that in at least from 65 to 70 per cent of the cases of lobar pneumonia the condition was due to type I or II. He believed also that group IV was more common in cases of conjunctivitis and ulcus serpens corneae than the more virulent types I, II and III. In a study of 3,682 cases of pneumonia caused by the pneumococcus at the Boston City Hospital, Finland[5] noted that in approximately 49 per cent the condition was due to type I, II or III but that other frequently occurring types were

TABLE 1.—*Relative Incidence and Mortality for the Four Original Types of Pneumococcus in Pneumonia*

Type of Pneumococcus	Incidence, Percentage	Mortality, Percentage
I	33	25
II	31	32
III	12	45
Group IV	24	16

V, VII, VIII, X and XIV. It is of some interest to note that he found the following types, in the order named, caused acute lobar pneumonia in 79 per cent of the cases: I, III, II, V, VIII and VII; in 50 per cent of cases of atypical pneumonia the condition was due to type III, VIII, X, XX, XVIII or VIII. In a study of 4,048 cases of endemic pneumonia at the Harlem Hospital, Bullowa and Wilcox[6] attempted to show the great variation of types as regards mortality, seasonal incidence, age groups, bacteremia and other aspects. Types II, III, XV and XXIII were found to be the most fatal for adults, while types XIII, XXVIII, XXIII and XV most often caused death in children.

4. Gundel, M. I.: Mikrobiologie, Immunbiologie, Epidemiologie der Pneumokokkenerkrankungen, Klin. Wchnschr. **12**:89-92 (Jan. 21) 1933.

5. Finland, M.: The Significance of Specific Pneumococcus Types of Disease, Including Types IV to XXXII (Cooper), Ann. Int. Med. **10**:1531-1543 (April) 1937.

6. Bullowa, J. G. M., and Wilcox, C.: Endemic Pneumonia: Pneumococcic Types and Their Variations in Incidence and Mortality for Adults and Children. Arch. Int. Med. **59**:394-407 (March) 1937.

Although studies concerning the types of pneumococcus in ocular diseases have been fragmentary, it is of interest to compare them with studies of the types found in the flora of the upper respiratory passages and in pneumonia. Table 2 is a compilation showing the types of pneumococcus demonstrated in ocular diseases by Lobeck,[7] Schmelzer and Eckstein,[8] Schmelzer,[9] Lundsgaard,[10] Bracci-Torsi,[11] Mikaëljan,[12] Cheney,[13] Vita,[14] McKee,[15] Jahnke and Wämoscher,[16] Marginesu and Corda,[17] Wright [18] and Lundsgaard.[19] A brief study of this table reveals the fact that only 25 per cent of the pneumococci occurring in ocular diseases belong to types I, II and III, and that 75 per cent are of group IV. The last group includes virulent organisms that are of great importance in pneumonia, but, because of increased frequency, their significance in ophthalmic practice is perhaps even greater.

---

7. Lobeck, E.: Zur Frage der Pneumokokkeninfektionen am Auge, Arch. f. Ophth. **127**:395-400 (Oct.) 1931.

8. Schmelzer, H., and Eckstein, E.: Die augenpathogene Bedeutung der Streptokokken und Pneumokokken (547 Untersuchungen), Arch. f. Ophth. **132**: 24-33 (March) 1934.

9. It appears that the work of H. Schmelzer (Zur Aetiologie und Therapie des eitrigen Hornhautgeschwüres, München. med. Wchnschr. **82**:1906-1907 [Nov. 29] 1935) includes cases of sulcus serpens corneae listed by Schmelzer and Eckstein [8] and that the latter work includes all the cases listed by Schmelzer (Pneumokokken und Streptokokken am Auge [Nach gemeinsamen Untersuchungen mit Eckstein]), Zentralbl. f. d. ges. Augenh. **27**:229, 1932).

10. Lundsgaard, K. K. K.: Pneumokokkeninfektionen des Auges: Prophylaxe und spezifische Therapie, Hospitalstid. **68**:505-518, 529, 545 and 553-564, 1925; abstr., Zentralbl. f. d. ges. Ophth. **15**:700-701, 1926.

11. Bracci-Torsi, H.: Dacriocistite e pneumococchi, Ann. di ottal. e clin. ocul. **61**:29-42 (Jan.) 1933; abstr., Zentralbl. f. d. ges. Ophth. **30**:113-114, 1933.

12. Mikaëljan, R. C.: Studien über den Pneumokokkus des Auges: I. Ueber Pneumokokkentypen bei einigen Augenerkrankungen, Klin. Monatsbl. f. Augenh. **87**:778-784 (Dec.) 1931.

13. Cheney, R. C.: Types of Pneumococcus Found in Corneal Ulcers, Internat. Cong. Ophth. **1**:378-382 (April) 1922.

14. Vita, A.: La classificazione immunologica moderna dei pneumococchi nella patologia oculare, Zentralbl. f. d. ges. Ophth. **19**:712-713, 1928.

15. McKee, S. H.: A Study of the Pneumococcus Group from the Inflamed Conjunctiva and Lacrimal Sac, Am. J. Ophth. **18**:1021-1029 (Nov.) 1935.

16. Jahnke, W., and Wämoscher, L.: Zur Frage der Serumtherapie bei Pneumokokkenerkrankungen des Auges, Ztschr. f. Augenh. **74**:215-222 (June) 1931.

17. Marginesu, P., and Corda: Studi sui pneumococchi, Atti d. r. Accad. d. fisiocrit. in Siena **15**:1-3, 1923-1924.

18. Wright, R. E.: Statistics and Professional Report of Government Ophthalmic Hospital, Madras, for the year 1924, Madras, India, Government Press, 1925; cited by Lundsgaard.[19]

19. Lundsgaard, K. K. K.: Acta ophth. **1**:73, 1923; Communicat. de l'Inst. sérothérap. de l'État Danois, 1924, p. 15.

Because of the apparent importance of pneumococci of group IV, a detailed study was made of 100 consecutive cases in which methemoglobin-producing organisms, i. e., Diplococcus pneumoniae and Streptococcus viridans, were recovered. The organisms were obtained in 14 cases from cultures of material from the conjunctival sac made as a routine preoperatively and in all the other cases in inflammatory diseases such as conjunctivitis, dacryocystitis, corneal ulcers, panophthalmitis and endophthalmitis. Blood agar plates streaked with a platinum loop were incubated forty-eight hours at 37 C. Subcultures were made, after twenty-four hours, in 1 per cent dextrose meat infusion broth and 1 per cent inulin. It was not possible to differentiate D. pneumoniae and Str. viridans from a study of the cultural characteristics alone. On blood agar the pneumococci usually grew as small, moist, translucent colonies with well defined edges; frequently a definite central depres-

TABLE 2.—*Types of Pneumococcus Demonstrated in Ocular Diseases by Various Investigators*

Condition	No. of Cases	Types I and II	Type I	Type II	Type III	Group IV
Panophthalmitis	2	..	1	..	..	1
Ulcus serpens corneae	131	..	5	9	20	97
Dacryocystitis	99	..	4	11	14	70
Acute conjunctivitis	59	..	..	2	8	49
Normal conjunctiva	59	..	1	2	8	48
Acute conjunctivitis and dacryocystitis	70	..	5	1	3	61
Ulcus serpens corneae and/or dacryocystitis	76	4	20	7	..	45
Total	496	4	36	32	53	371

sion appeared in the colony after twenty-four hours. The colonies of Str. viridans were drier, smaller, more opaque and more coarsely granular than those of pneumococci, although in some instances one would have been in error to use these criteria as a means of differentiation. A halo of green hemolysis was present around the colonies of each type. In dextrose meat infusion broth the pneumococci produced a diffuse growth, while the streptococci usually settled to the bottom of the tubes. It is interesting to note that in this medium streptococci frequently grew in extremely long chains, whereas pneumococci grew in pairs or short chains of not more than ten organisms.

Both streptococci and pneumococci, when grown in meat infusion broth, often appeared elongated when stained with Gram's stain. When applied to secretions taken directly from the eye, the Gram stain often showed typical diplococci; this suggested the presence of pneumococcus, but further investigation often revealed a streptococcus. However, in a number of stains of ocular secretions, streptococci in long chains

were noted. The stain for capsules of Bailey [20] was applied to a small number of smears of secretion taken directly from the eye, and in 5 cases of dacryocystitis capsules were present; the organisms were subsequently identified as pneumococci. It is altogether probable that if a more thorough search were made for capsules they would be found more frequently in pneumococcic infections.

When sufficient growth had occurred in the dextrose meat infusion broth (after from ten to twelve hours) the bile solubility was determined by means of a 10 per cent solution of sodium taurocholate, and the type of pneumococcus was ascertained by macroscopic agglutination.[21] In this series all the organisms agglutinated by antipneumococcic serum, i. e., pneumococci, were bile soluble and fermented inulin, the latter often being coagulated, but those organisms which were not agglutinated, i. e., streptococci, neither were bile soluble nor fermented inulin.

In table 3 the incidence of D. pneumoniae and Str. viridans in various ocular conditions is tabulated. Among the 100 cases, in 56 per cent the condition was due to D. pneumoniae, while in 44 per cent it was due to Str. viridans. In only 12 per cent of the former were the organisms types I, II or III, while in 88 per cent they were of group IV; this proportion is similar to the tabulation (table 2) based on a review of the literature. It demonstrates the importance of group IV, and the value of more specific knowledge concerning it, if specific antiserums are to be of therapeutic value in ophthalmic practice. In general, from table 3 one concludes that the more acute diseases are due to pneumococci and the less acute ones are due to streptococci. The incidence of pneumococci and streptococci appearing on fourteen normal conjunctivae was the same. Str. viridans was the cause of chronic conjunctivitis in twice as many cases as pneumococcus, but in subacute conjunctivitis the ratio of the incidence of streptococci to pneumococci was 4:3. Pneumococci, occurring in 18 of the 22 cases of acute conjunctivitis, were the most important and most frequent etiologic agents in this condition. Of 3 cases of panophthalmitis, pneumococci were the infecting organisms in 2. In the only case of endophthalmitis the condition was due to Str. viridans. Pneumococcus was observed in only 1 case of ulcus serpens corneae, while in 3 Str. viridans was identified; in 2 cases of ulcus serpens corneae associated with chronic

20. Bailey, H. D.: A Flagella and Capsule Stain for Bacteria, Proc. Soc. Exper. Biol. & Med. **27**:111-112 (Nov.) 1929.

21. The antipneumococcic serums in this work were obtained through the late Miss Georgia Cooper, of the Bureau of Laboratories of the New York City Department of Health. Serums XXVI and XXX have been omitted, as the former is probably identical with serum VI and the latter is closely related to, or identical with, serum XV.

purulent dacryocystitis, pneumococci were demonstrated in the ocular secretions. Thirteen cases of chronic purulent dacryocystitis are included in this series; in 10 cases pneumococci were observed, while in 3 Str. viridans was the causal agent.

Table 3 shows the incidence of the various types of pneumococci and of streptococci in ocular diseases from which organisms were

TABLE 3.—*Incidence of Diplococcus Pneumoniae and Streptococcus Viridans in One Hundred Cases of Ocular Conditions*

Condition	No. of Cases	Strepto-coccus	Pneumo-coccus
Normal conjunctiva (preoperative cultures)	14		
D. pneumoniae, types V, IX, X, XIII, XVII (2), XXXI			7
Str. viridans		7	
Chronic conjunctivitis	13		
D. pneumoniae, types IX, XIII, XIV, XXXII			4
Str. viridans		9	
Subacute conjunctivitis	28		
D. pneumoniae, types I, VII (2), X (2), XII, XIII, XIV (2), XVII, XXIII (2)			12
Str. viridans		16	
Acute conjunctivitis	22		
D. pneumoniae, types I (2), II, V, VII (3), VIII, X (2), XII, XIII, XVI, XX (2), XXIII, XXVIII (3), (in one case both VII and XX)			19
Str. viridans		4	
Panophthalmitis	3		
D. pneumoniae, types III, X			2
Str. viridans		1	
Endophthalmitis	1		
D. pneumoniae			
Str. viridans		1	
Corneal ulcer	4		
D. pneumoniae, type VIII			1
Str. viridans		3	
Chronic purulent dacryocystitis	13		
D. pneumoniae, types I (2), XI A and B, VII, XII, XIV (2) XIX, XXIII (2)			10
Str. viridans		3	
Corneal ulcer and chronic purulent dacryocystitis	2		
D. pneumoniae, types VI A and B, XXIII			2
Str. viridans			
Total	100	44	57

obtained for this study. Table 4 presents the incidence of the various types of pneumococci; types VII, X, XXIII, I, XIV and XIII, in the order named, were obtained most frequently. In only 1 instance were two types present; this was a case of acute conjunctivitis, in which types VII and XX were demonstrated. Only ten types were not represented in this series.

In several cases the clinical observations associated with this study were of interest. A 60 year old man was admitted to the hospital

because of a conjunctival cyst at the nasal limbus of the right eye. There was a history of injury to this eye forty years previously; the cyst had enlarged recently, but otherwise the eye had given him no discomfort. A culture on blood agar was made from material taken from the conjunctival sac. It was believed that the growth was a simple inclusion cyst, and it was punctured and some fluid removed. The following morning pneumococci were noted on the blood agar plate. Panophthalmitis developed, and on the third day the eye was enucleated. The next morning rigidity of the neck appeared, and a blood culture and a culture made from the spinal fluid grew pneumococci. Organisms from all three sources were agglutinated by the type X antipneumococcus serum. In another patient endophthalmitis followed by septicemia and meningitis developed after a foreign body had entered the eye. The organisms from the vitreous, blood stream and spinal fluid appeared to be similar,

TABLE 4.—*Incidence of Various Types of Diplococcus Pneumoniae in One Hundred Cases of Ocular Conditions*

Type	No. of Cases	Type	No. of Cases	Type	No. of Cases
I	5	IX	2	XIX	1
II	1	X	6	XX	2
III	1	XII	3	XXIII	6
V	2	XIII	4	XXVIII	3
VI A and B	2	XIV	5	XXXI	1
VII	6	XVI	1	XXXII	1
VIII	2	XVII	3		
Total					57

but none reacted with any of the antipneumococcic serums, and it was concluded that in all probability Str. viridans was the etiologic agent. In both these cases the condition was fatal. In a third case, one of dacryocystitis in a young child, the condition was found to be due to a type I pneumococcus. After a period of conservative treatment the child was discharged from the hospital apparently cured, since all cultures were negative and the lacrimal apparatus was patent, but she returned three months later with purulent dacryocystitis, and a type I pneumococcus was again recovered. The infection had apparently remained latent, as the same type of organism was recovered each time a bacteriologic study was made.

SUMMARY

Studies were made of D. pneumoniae and Str. viridans in 100 consecutive cases in which these organisms were isolated. In 86 instances the organisms were recovered in cases of ocular inflammation, i. e., conjunctivitis, dacryocystitis, corneal ulcer, panophthalmitis or endoph-

thalmitis, and in 14 instances they were isolated from cultures made as a routine before operation for cataract.

D. pneumoniae occurred in 56 per cent of the cases; in 88 per cent of these the organism was of group IV and in 12 per cent of type I, II or III. In order of frequency, the most common types were VII, X, XXIII, I, XIV and XIII. Only ten of the thirty-two known types were not represented. Str. viridans occurred in 44 per cent of the cases.

All the organisms which were agglutinated by the antipneumococcic serums were bile soluble and fermented inulin, while those that were not agglutinated neither were bile soluble nor fermented inulin.

A SPECIAL FORM OF KERATITIS CAUSED BY FRIEDLÄNDER'S PNEUMOBACILLUS

REPORT OF A CASE, WITH REVIEW OF THE LITERATURE

S. P. CHANG, M.D.
PEIPING, CHINA

The pneumobacillus was discovered by C. Friedländer [1] in the fibrinous bronchial exudate and in the pulmonary alveolar tissue of patients with pneumonia. This organism is a short, plump bacillus, subject to great variation in size. It measures, on the average, from 0.5 to 1.5 microns in width and from 0.6 to 5 microns in length. It is gram-negative and immotile. It has no flagella or spores but possesses a capsule and grows luxuriantly on blood agar. It belongs to the general group of Bacillus mucosus-capsulatus. Strong [2] and Perkins [3] made important contributions toward its isolation and differentiation from other species of the same group by means of formation of gas and fermentation of sugar. Fricke [4] and Clairmont [5] studied thoroughly the distribution of the organism and found that it exists in the nose, mouth, saliva and gastro-intestinal tract of healthy persons, as well as in the various inflammatory lesions of various internal organs. Talamon,[6] who first experimented on animals with this organism, stated that rabbits are less sensitive to this organism than to the lancet form of diplococci obtained from the sputum and blood of patients with pneumonia. Foà and Rattone [7] proved that guinea-pigs are extremely sensitive to this organism. These animals usually died of peritonitis two or three days after an abdominal inoculation. In his investigations on this organism, which included its differentiation from the Fränkel diplococci, Fränkel [8] showed that there are cultural as well as pathogenic differences between the two organisms, the pneumobacillus being able to kill mice while the Fränkel diplococcus cannot do so.

From the Department of Ophthalmology, the Peiping Union Medical College.

1. Friedländer, C.: Virchows Arch. f. path. Anat. **87**:319, 1882.
2. Strong, L. W.: Zentralbl. f. Bakt. **25**:49, 1899.
3. Perkins, Roger G.: J. Infect. Dis. **1**:241, 1904.
4. Fricke, C.: Ztschr. f. Hyg. **23**:380, 1896.
5. Clairmont, C.: Ztschr. f. Hyg. **39**:1, 1902.
6. Talamon, C.: Progrès méd. **11**:1030, 1883.
7. Foà, P., and Rattone, G.: Arch. ital. de biol. **6**:366, 1884-1885.
8. Fränkel, A.: Ztschr. f. klin. Med. **10**:402, 1886.

The importance of this organism in ophthalmology was first emphasized by Perles,[9] who made experiments on different animals. His technic of inoculation was, briefly, as follows: Three parts of the eye of the animal were chosen for the experiment, namely, the cornea, the anterior chamber and the vitreous cavity. For inoculation of the cornea, a pocket wound was made with a sharp keratome to the depth of Descemet's membrane; into this wound the bacterial emulsion was introduced with a platinum needle. For inoculation of the anterior chamber, the cornea was incised with a Graefe knife, and a large amount of the pure culture of the organism was placed on the surface of the iris with a spatula. The method used for the inoculation of the vitreous cavity was similar to that used for the inoculation of the anterior chamber; the undiluted culture was injected into the vitreous. The day following the inoculation into the cornea of the rabbit a great amount of purulent discharge was found in the conjunctival sac. The wound of the cornea was infiltrated and covered with some whitish exudate which could not be wiped off; the other parts of the cornea were clear. On the third day after inoculation, the purulent discharge increased in amount, but the conjunctiva showed no remarkable redness or swelling. The area of infiltration of the inoculated area in the cornea was the same size as formerly, but its center had become necrotic and was easily removed. The other parts of the cornea became grayish. The anterior chamber was free from pathologic changes. A large number of pneumobacilli were present in the conjunctival discharge. Histologic examination showed an ulcer involving two thirds of the thickness of the cornea. Panophthalmitis developed as a result of inoculation of the anterior chamber and the vitreous cavity. Bursuk[10] and Pivovarov[11] inoculated the rabbit's cornea with the pneumobacillus, and the cornea subsequently showed a grayish disciform opacity, superficially situated, slightly elevated and surrounded by numerous tiny areas of infiltrate.

Terson and Gabrielidès[12] claimed that the organism is frequently present in the conjunctivae of patients with ozena and is often responsible for infections of the eye following epithelial injury and operations. Cuénod,[13] Uhthoff[14] and Axenfeld[15] stated that they did not agree with this statement; they said that not only did they

9. Perles, M.: Virchows Arch. f. path. Anat. **140**:231, 1895.
10. Bursuk, G.: Zentralbl. f. d. ges. Ophth. **29**:94, 1933.
11. Pivovarov, V.: Sovet. vestnik oftal. **1**:508, 1932.
12. Terson, A., and Gabrielidès, A.: Arch. d'opht. **14**:488, 1894.
13. Cuénod, A.: Arch. d'opht. **14**:495, 1894.
14. Uhthoff, W.: Arch. f. Ophth. **42**:1, 1896.
15. Axenfeld, T.: Die Bakteriologie in der Augenheilkunde, Jena, Gustav Fischer, 1907, pp. 222-226.

not observe this organism in the conjunctivae, but they noted it only seldom in the pus from the lacrimal sacs of patients with ozena. Axenfeld [15] was only occasionally able to cultivate this organism from the conjunctivae of catarrhal eyes, but he recovered it abundantly from the conjunctivae of eyes with chronic conjunctivitis associated with chronic dacryocystitis. Gourfein [16] observed the micro-organism in pus from an eye with dacryocystitis in four of forty cases in which there were no nasal lesions. Sattler [17] discovered it in pus from the lacrimal sac. Etienne [18] recovered it from the discharge of an eye in a case of dacryocystitis associated with corneal ulcer. Brayley, Eyre and Kreseritzki,[19] Gonin,[20] Zia,[21] Derby [22] and Hirota [23] encountered it in cases of conjunctivitis, acute or subacute, which, according to Derby [22] and other authors, is very resistant to any local treatment. No epidemic conjunctivitis caused by this organism has been recorded, nor has inoculation of human eyes been reported. The organism was recovered from the pus from an inflamed chalazion by Maklakow,[24] Cosenza [25] and Henriksen.[26] The latter, moreover, obtained positive agglutination and complement fixation reactions from the blood of his patient.

Groenouw [27] once noted the pneumobacillus in abundant numbers in an eye with almost healed blennorrhea neonatorum. He considered this organism merely an agent in the production of a mixed infection in this case. He isolated it from his patient and inoculated it into the cornea of a rabbit, the eye of which subsequently showed a whitish infiltrate in the cornea without hypopyon. Then he instilled a pure culture of this organism into the conjunctival sac of another rabbit; the conjunctiva was purposely injured before the inoculation. Two days after the inoculation the conjunctiva showed very slight redness, while the cornea showed a grayish infiltrate in its lower part. Therefore, he considered this organism as being more pathogenic for the cornea than for the conjunctiva.

16. Gourfein: Rev. méd. de la Suisse Rom. **22**:119, 1902.
17. Sattler, H., in Axenfeld,[15] p. 226.
18. Etienne, G., in Axenfeld,[15] p. 226.
19. Brayley, Eyre and Kreseritzki, in Axenfeld,[15] p. 224.
20. Gonin, J.: Rev. méd. de la Suisse Rom. **19**:89, 1899.
21. Zia, in Axenfeld,[15] p. 224.
22. Derby, G. S.: Am. J. Ophth. **22**:1, 1905.
23. Hirota, K.: Ueber die Mikroorganismen im Sekret der Conjunctivitis catarrhalis und im Bindehautsack des gesunden Auges, Inaug. Dissert., Halle, C. A. Kaemmerer & Co., 1901.
24. Maklakow, A.: Arch. f. Augenh. **43**:10, 1901.
25. Cosenza, G.: Boll d'ocul. **8**:1090, 1929.
26. Henriksen, S. D.: Norsk mag. f. lægevidensk. **94**:1248, 1933; Zentralbl. f. d. ges. Ophth. **31**:150, 1934.
27. Groenouw, A.: Arch. f. Ophth. **52**:51, 1901.

The pneumobacillus has been reported by many authors as being the causal agent of corneal lesions. Stoewer [28] reported a case of deep corneal ulcer caused by this organism following trauma. The eye presented the clinical picture of atypical serpent ulcer, which healed rapidly without perforation. Gourfein [16] observed the organism in a case of typical serpent ulcer. Gonin [20] observed it in two of ten cases of catarrhal ulcer. Basso [29] recovered it from material from a corneal ulcer and from material from the nose of a patient with ozena. Loeb [30] observed the organism in scrapings from the corneal ulcer in a child with keratomalacia; this could be considered only as a secondary infection. Wopfner [31] reported a case of metastatic panophthalmitis following croupous pneumonia in which the pneumobacillus was observed in both the eye and the lung.

A case of keratitis caused by the pneumobacillus is reported here because of the rarity of the disease and because of the peculiar clinical picture.

REPORT OF CASE

History.—A Chinese man aged 26 years was admitted to the ophthalmologic service of the Peiping Union Medical College Hospital on Oct. 23, 1936, because of a whitish spot at the lower periphery of the left cornea. His eyes had been normal until about twenty days before his admission to the hospital, when this whitish spot, associated with a small amount of mucoid discharge and slight local discomfort, was noticed. It had remained stationary in size.

Ophthalmic and General Examination.—The right eye was found to be normal except for moderate amblyopia. The left eye showed slight congestion of the bulbar and the palpebral conjunctiva, an inflamed chalazion in the lower lid and an interesting corneal lesion: a sharply defined whitish spot, measuring about 3 by 1.5 mm., was located near the limbus at 6:30 o'clock. The surface of the lesion was slightly elevated, dry and granular. Slit lamp examination revealed that the lesion occupied only the superficial layers of the cornea and the epithelium in the area of the lesion was absent. There were two small, roundish, whitish patches, each about 0.5 mm. in diameter, one on each side of the lesion, with fine opacities in their neighborhood. Superficial vessels were growing into and around the lesion. A number of grayish dots located in the epithelium and staining with fluorescein were seen scattered over the periphery of the cornea (fig. 1). Otherwise the left eye was normal. Vision of the eye was 6/6 and the patient was able to read Jaeger's test type 1. The lacrimal secretion was found to be present in normal amounts by Schirmer's method. The corneal sensation and the dark adaptation of each eye were normal. The lacrimal passages on each side were patent. No lesion was found in the nose by the otolaryngologist. Physical examination revealed nothing important. The Wassermann reaction of the blood was negative.

On October 24, the day after admission, a portion of the lesion was scraped off for microscopic examination. It consisted of cellular débris and gram-negative

28. Stoewer, P.: Klin. Monatsbl. f. Augenh. **45**:560, 1907.
29. Basso: Clin. ocul. **4**:1479, 1903.
30. Loeb: Zentralbl. f. Bakt. **10**:369, 1891.
31. Wopfner: Klin. Monatsbl. f. Augenh. **43**:402, 1905.

bacilli. After scraping, a shallow depression with a smooth surface was left. Two days later the depression had filled in, and the lesion assumed its original appearance.

In order to rule out vitamin A deficiency, carotene was given, without any effect.

Bacteriologic Examination.—The gram-negative bacilli which were recovered from material from the corneal lesion, from material from normal parts of the left cornea and from material from the chalazion in the left lower lid were identified as Friedländer's pneumobacilli. Cultures of the scrapings from the conjunctiva and the cornea of the right eye showed the same bacilli, although there the colonies were scanty. A smear culture of material from the nose gave a luxuriant growth of the same organism. To rule out a fungus as a possible causative agent, several Sabouraud dextrose agar plates were inoculated with material from the lesion, but no growth was obtained.

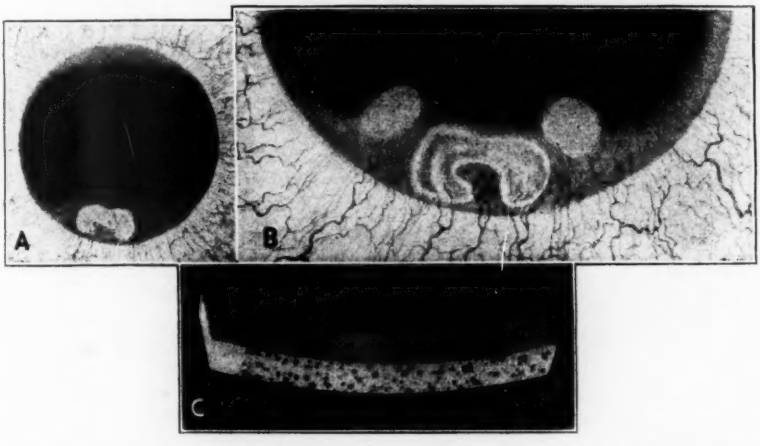


Fig. 1.—*A*, the corneal lesion as seen with the loupe; *B*, the corneal lesion as seen with the slit lamp; *C*, epithelial infiltrations (stained with fluorescein) at the periphery of the cornea.

Experiments on Animals.—Perles'[9] technic was applied. One guinea-pig and two mice were inoculated intraperitoneally with an emulsion of the pure culture; these animals died of peritonitis twenty-four hours after the inoculation. The abdominal fluid showed a postive culture of the pneumobacillus.

On November 13 an intracorneal inoculation was made in one rabbit. The next day the cornea showed dense infiltration along the track of the wound. On the third day the infiltration became denser and more widespread. The corneal epithelium became edematous. On November 17, four days after the inoculation, the condition of the cornea began to improve. The edema of the epithelium was diminishing, and the infiltration became demarcated (fig. 2 *A*). On November 18 the top of the infiltrate broke off; there a small ulcer developed, while the epithelium over the rest of the infiltration remained intact. On November 19 both superficial and deep blood vessels were growing toward the infiltration. On November 23 the vessels had reached the area of infiltration, which meanwhile had become much smaller. The ulcerated part was gradually becoming covered with epithe-

lium. On November 26 the area of infiltration was still smaller, and the blood vessels had decreased in number (fig. 2 *B*). The improvement continued until December 4, when only a small scar remained in the middle layer of the cornea. Culture of material from the infiltration showed the pneumobacillus.

Inoculation was made into the anterior chamber of another rabbit on November 13. The next day the aqueous was opaque, and the iris was covered by exudate. On November 15 the deep layers of the cornea were infiltrated, and the iris was very hyperemic. On November 17 the condition of the iris was becoming worse, but on November 19 the exudate began to be absorbed. On November 20 the exudate in the chamber had decreased so markedly that the iris was entirely free from it. The pupillary area was, however, still covered by some exudate. On November 23 the pupillary exudate also disappeared. The condition continued to improve up to December 4, when the eye was restored to its normal state.

Inoculation was made into the vitreous cavity of four rabbits. All of them showed the following conditions: Chemosis of the bulbar conjunctiva occurred on the second day after the inoculation. The aqueous became cloudy and the iris hyperemic. Two or three days later, exudate was found in the anterior chamber. Grayish exudate and sometimes hemorrhages were visible in the vitreous. After

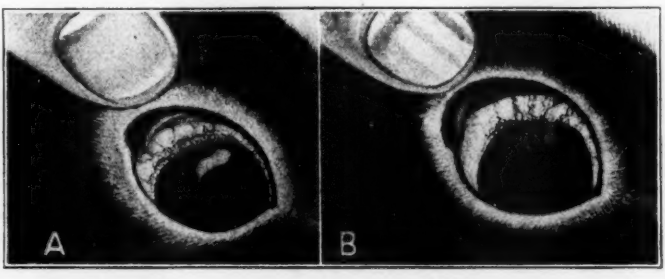


Fig. 2.—*A*, infiltration of the rabbit's cornea following inoculation of the pneumobacillus; *B*, healing stage of the experimental corneal lesion in the rabbit's eye.

six or eight days the chemosis and the exudate in the anterior chamber disappeared, but the opacity in the vitreous was persistent and even increased in density. Detachment of the retina was found in all the eyes.

Treatment and Outcome.—After the investigations were finished, the corneal lesion of the patient was treated by removal of the opaque layer with a keratome, which was followed by diathermic cauterization. The defect produced was superficial and healed promptly, leaving a small vascularized scar.

COMMENT

When the corneal lesion was seen for the first time, it presented a clinical picture which led one to consider keratomycosis, xerosis corneae or keratoconjunctivitis sicca. Repeated failure to observe fungi ruled out keratomycosis. The patient had no local or general signs of vitamin A deficiency. The dark adaptation was normal, and no improvement followed the administration of carotene (vitamin A preparation). Thus the possibility of xerosis was eliminated. Since the lacrimal secretion was normal, keratoconjunctivitis sicca could also be excluded.

It was not until the pneumobacillus was recovered from the lesion and the results of the subsequent inoculation experiments were positive that it was established as the causative agent. The conclusion that the disease was caused by the pneumobacillus is borne out by the following facts:

1. The pneumobacillus was the only organism observed in the corneal lesion.

2. It was virulent enough to produce lesions in experimental animals, from which it could be recovered.

3. Material from the diseased eye gave a much richer cultural growth of the organism than material from the normal eye.

4. According to Gourfein,[16] the organism is rarely seen as a saprophyte in the conjunctival sac.

SUMMARY

A case of superficial keratitis caused by Friedländer's pneumobacillus is reported.

The pneumobacillus was recovered from the conjunctiva, the cornea and the inflamed meibomian gland of the affected eye, from the conjunctiva of the other eye, which was clinically normal, and from the nose.

Inoculation of the organism into the corneas, the anterior chambers and the vitreous cavities of experimental animals produced severe lesions.

The clinical picture of the corneal lesion was peculiar, suggesting keratomycosis, xerosis or keratoconjunctivitis sicca rather than an infection with a virulent micro-organism.

Clinical Notes

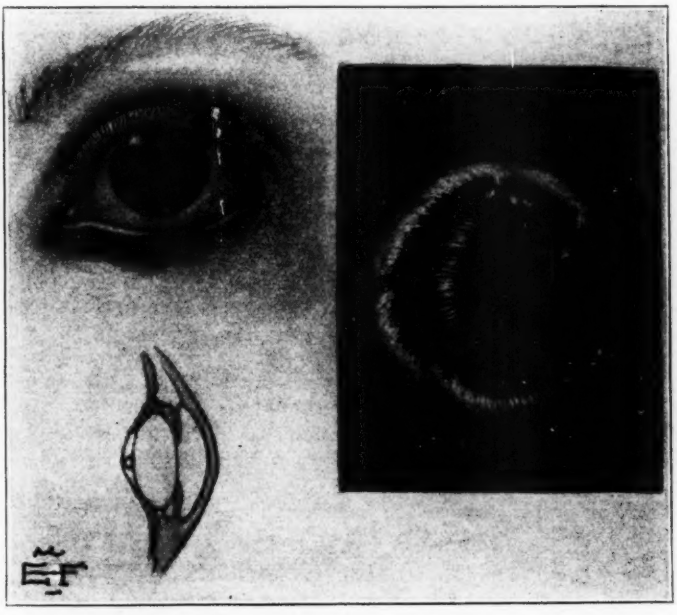
CYSTLIKE REMAINS OF THE VASA HYALOIDEA PROPRIA

JOSEPH ZIPORKES, M.D., NEW YORK

REPORT OF CASE

A case in which cystlike remains of the vasa hyaloidea propria were observed is reported as follows:

R. L., a boy 13 years of age, was referred for examination because of convergent concomitant squint of the left eye of 20 degrees. Vision of the right eye



Drawings showing appearance and location of the cyst.

was 20/20, and that of the left eye was 20/100 and was not improved. The pupils, the tension and the fundi were normal. With direct illumination, there was seen to be present on the posterior pole of the left lens a white opacity resembling a posterior polar cataract. With the slit lamp the detailed examination of this opacity revealed:

In the retrolental space and attached by a strand of pigment slightly nasal to the posterior pole of the left lens was a globular, semitransparent cyst, about 1 by 0.5 mm. in diameter. It was sharply circumscribed but not entirely spherical. Scattered in this cyst were a number of fine particles of brown pigment. Strands running through the cyst gave it a multilocular appearance. Extending from the edges of the cyst, as well as from the posterior surface of the lens, were the

Read before the Clinical Society of the Herman Knapp Memorial Hospital, May 20, 1937.

spiral and corkscrew remains of the vasa hyaloidea propria. The retrolental space did not contain cells or elements other than those just mentioned and was relatively very deep.

COMMENT

The congenital anomaly just described is not a common one.

Lavery [1] reported a case of cyst of the vitreous back of the retrolental space following an injury. Vision was 20/20. He did not describe the appearance of cyst or give other details.

Koby,[2] in his text "Slit-Lamp Microscopy of the Living Eye," included a drawing of a transparent pigmented spherical body in the retrolental space. In the legend accompanying the drawing he stated that this spherical body was between two layers of the posterior capsule of the lens. But in the description he mentioned that it was attached to the posterior capsule of the lens. It was not connected with the hyaloid artery, though that was present.

In an article published later Koby [3] again described the case previously reported and added another. In this he described as a relic of the hyaloid artery the anomaly observed in the form of a whitish pear-shaped mass attached by a network of vessels to the posterior capsule of the lens.

Bernard Samuels [4] in a paper on opacities of the vitreous spoke of spheres of tissue of the vitreous, with or without pigment. Their origin was either from broken-down coagulated stroma or from verrucae of the lamina vitrea which had worked their way through the entire thickness of the retina. However, the anomaly present in my case, though it can be spoken of as a cyst of the vitreous, is not grouped under that classification.

1. Lavery, F. S.: Cyst in Vitreous Humor, Tr. Ophth. Soc. U. Kingdom **52**:578, 1932.

2. Koby, F. E.: Slit-Lamp Microscopy of the Living Eye, ed. 2, Philadelphia, P. Blakiston's Son & Co., 1930.

3. Koby, F. E.: Biomicroscopie du corps vitré, Bull. et mém. Soc. franç. d'opht. **45**:15, 1932.

4. Samuels, Bernard: Opacities of the Vitreous, Tr. Ophth. Soc. U. Kingdom **50**:414, 1930.

RAYNAUD'S DISEASE WITH INTERMITTENT SPASM OF THE RETINAL ARTERY AND VEINS

Follow-Up Report of a Case

W. M. CARPENTER, M.D., AND E. W. CARPENTER, M.D.
GREENVILLE, S. C.

Todd [1] in an article published in 1912 suggested that vascular spasms are not always spastic but may be intermittent and are not always fatal to the parts involved.

"According to the present state of our knowledge, angiospasm alone can never lead to gangrene and can only be regarded as a secondary

1. Todd, T. W.: The Vascular Symptoms in "Cervical" Rib, Lancet **2**:362, 1912.

factor in its production."[2] This is not in accordance with the usual conception of Raynaud's disease. One would think that spasm of the central artery would lead to death of the retina, because the retina is entirely dependent on the central artery for nourishment. In visualizing the sequence in the pathologic changes of Raynaud's disease one must first settle the question, Is the spasm spastic or intermittent? In reviewing the subject we have concluded that the usual state of affairs is intermittence and that these attacks are not always fatal to the part involved. Sometimes function is distorted, and at other times organic dissolution takes place.

In the case which we are reporting there is functional destruction without complete dissolution of the retina. A preliminary report of this case was published in the ARCHIVES.[3] The patient was first seen by Dr. E. B. Gray, of Spartanburg, S. C., on Oct. 23, 1936, and was seen last by us on Aug. 6, 1937.

On the patient's first visit to us, on Oct. 26, 1936, the right eye was blind except for dim perception of bright light. The pupil was normal in size and did not react to direct light but did react to indirect light. The binocular ophthalmoscope revealed that the retina was pale and moderately blurred. Between the disk and the temporal side were numerous superficial patches of striate hemorrhage. All the arteries appeared as white streaks; three secondary veins contained small segments of blood, and there was a red spot in the center of the macula. While we were meditating on this picture and wondering why the segments of blood were in the veins and why the retina was not whiter and more atrophic, as the patient had been blind for two or three months, a primary artery suddenly shot full of blood to the point where it divided. Then another arterial trunk and another showed this phenomenon in lightning-like rapidity, and the appearance suggested the spokes of a cart-wheel. The next change in the picture was a similar filling of the secondary arteries and then of the veins. This phenomenon was repeated every few moments for over two hours. We demonstrated it to several physicians.

Two weeks after the patient's first visit all the retinal vessels were full except one small artery below the macula. The intermittent filling and emptying still occurred but at longer intervals. The filling of the primary arteries was followed by filling of the secondary twigs and of the veins in such a rapid sequence that it is difficult to measure the interval in time. The striate hemorrhage was subsiding. This denoted that the metabolism of the retina was active. But the eye was blind, which meant that the intermittent absence of blood had caused the death of the ganglion cells. The empty artery under the macula suggested a sectional spasm. The segments of blood in the veins on the first visit also suggested a sectional spasm of the veins. This raises the question whether the spasm was an impulse arising in a central vessel and proceeding like a wave or whether it was an impulse projected

2. Tice, Frederick: Practice of Medicine, Hagerstown, Md., W. F. Prior Company, Inc., 1927, vol. 10, p. 650.

3. Anderson, R. G., and Gray, E. B.: Spasm of the Central Retinal Artery in Raynaud's Disease: Report of a Case. Arch. Ophth. **17**:662 (April) 1937.

over the whole area instantaneously. We believe that the wave impulse was sustained by the phenomena in the case.

It was interesting to note the movement of the segments of blood which were trapped in the primary vein stems. As soon as the primary arteries dilated, these segments shot forward with great rapidity, showing that the veins dilated almost synchronously with the arteries. When the patient was last seen, on Aug. 6, 1937, the following picture was noted: The disk was snow-white. The cribriform plate was conspicuous. The primary arteries had tiny central red streaks, and their walls were visible. No secondary arteries were visible. The veins were about one-third the normal size, were pale and contained blood; secondary branches were visible. The retina was paler than normal. The macula showed a red center; macular markings were absent, and the macular region was surrounded by a silver reflex ring. This condition demonstrated that there was not complete spasm of all the retinal vessels and that, while the function of the retina had been abolished, organic dissolution was not complete.

When Raynaud's disease attacks the extremities, dissolution is sooner or later complete.

The patient had fifteen doses of acetylcholine. At this time there were several painful petechial spots on the tip of the little finger of the left hand.

What is the explanation for the continued physical integrity of the retina? It must be that the fine central arterial line represented blood, and this was sufficient to sustain the status quo. The obliteration of the circulation was incomplete because the spasm impulse was insufficient to obliterate completely the arterial caliber up to this time.

The main reason for this contribution is the observation of the retinal vascular spasm over such a length of time.

Because the phenomena seen in this case are unique, we believe they should be recorded.

Ophthalmologic Review

THE CATARACTOUS LENS

EXPERIMENTAL AND CLINICAL STUDIES

I. S. TASSMAN, M.D.
PHILADELPHIA

After the earlier investigations of the lens proteins by Mörner, Jess and others, the study of the chemical structure of the lens and analysis of the fractions and their properties continued to be of great interest to others in attempting to explain the development of senile cataract.

Among the later studies of the chemical structure of the lens were those made by Krause,[1] who found that the crystallins corresponded to albumins, with the percentages of arginine, histidine, lysine and tyrosine present somewhat higher than those obtained by Jess. He also found a percentage of cysteine in the normal lens lower than the percentages reported by earlier investigators. Krause also studied the molecular weight of the lens proteins.

The weight and the nitrogen and water content of the crystalline lens were investigated by P. W. Salit [2] and J. Kubik.[3] Salit found that the water content of the normal lenses of cattle decreases with age. The weight of the lenses of calves increases with age. Kubik found that with the formation of cataract in the human lens there is a gradual decrease in the weight of the lens, and the more mature the cataract, the greater the loss of weight.

THE LIPIDS

The lipids of normal and cataractous lenses were investigated by Salit,[4] Krause [5] and others. It was agreed by most investigators that

1. Krause, Arlington: Chemistry of the Lens: Composition of Beta Crystallin, Albumin (Gamma Crystallin) and Capsule, Arch. Ophth. **9**:617 (April) 1933; Chemistry of the Lens: Relation of Anatomic Distribution of Lenticular Proteins to Their Chemical Composition, ibid. **10**:788 (Dec.) 1933.

2. Salit, P. W.: Biochemical Investigation of Nitrogen, Weight and Water Content of Crystalline Lenses, Arch. Ophth. **5**:623 (April) 1931.

3. Kubik, J.: Arch. f. Augenh. **102**:675 (Feb.) 1930.

4. Salit, P. W.: Biochemistry of the Aqueous, Lens and Vitreous, Arch. Ophth. **4**:374 (Sept.) 1930; Chemical Studies of the Lipids of the Normal Animal Lenses, Cataractous Human Lenses, and Blood of Patients with Cataract, ibid. **5**:354 (March) 1931.

5. Krause, Arlington: Chemistry of the Lens: Lipids, Arch. Ophth. **13**:187 (Feb.) 1935; Biochemistry of the Eye, ibid. **15**:522 (March) 1936.

the values for cholesterol and lecithin varied little in the normal lens at any age. In cataractous lenses, however, the cholesterol content was found to be above normal and the lecithin content at the upper limit of normal. Salit agreed with O'Brien and Myers that the cholesterol content of the blood was somewhat above normal also. Michael and Vancea had also previously produced experimental hypercholesteremia in rabbits which were fed naphthalene. They felt that this condition was the result of a reaction of the organism in combating a poison. Salit and O'Brien [6] also analyzed the amount of cholesterol in the various stages of cataract and found in one hundred and four cases that the variations were more or less the same in all stages and that the lenses as a group did not differ in cholesterol content from normal lenses of similar age. They did find that in the normal lens of a 16 year old girl the cholesterol content was less than that found in the lens of an 86 year old woman. In the latter, however, the content was the same as the average for cataractous lenses of patients of similar age.

THE CALCIUM CONTENT

The calcium content of the normal and of the cataractous lens has been studied by Salit,[7] Kirby,[8] Grabar and Nordmann,[9] Adams [10] and others. It was found that normal lenses of persons of different ages vary little in their calcium content. In cases of senile cataract, however, the calcium content of the lens was found to be greatly increased. This was considered to be the result of a purely local disturbance, since most of the investigators found no significant deviations of the calcium content of the serum in patients with cataract.

Kirby,[8] who did an enormous amount of work on the subject, also confirmed the finding of increased amounts of calcium in cataractous lenses. He considered that this increase was a secondary change and not a primary factor, especially since no increase in the calcium content had been found in the early stages of cataract. Kirby also investigated

6. Salit, P. W., and O'Brien, C. S.: Cholesterol Content of Cataractous Human Lenses, Arch. Ophth. **13**:227 (Feb.) 1935.

7. Salit, P. W.: Calcium Determinations on Cataractous Human Lenses, Am. J. Ophth. **13**:1072 (Dec.) 1930; Calcium Content and Weight of Human Cataractous Lenses, Arch. Ophth. **9**:571 (April) 1933; Etiology and Chemical Nature of Cataractous Lenses, Am. J. Ophth. **14**:523 (June) 1931.

8. Kirby, D. B.: Calcium in Relation to Cataract: In Vitro, Arch. Ophth. **5**:856 (June) 1931.

9. Grabar, P., and Nordmann, J.: Compt. rend. Soc. de biol. **112**:1534 (May 2) 1933.

10. Adams, D. R.: Rôle of Calcium in Senile Cataract, Biochem. J. **23**:902, 1929.

the calcium level of the serum in cases of senile cataract and found no variations according to age, sex, the type of cataract or complicating ocular or general disease. There was no evidence of calcium deficiency, as far as the values for the blood serum were concerned, in cases of senile cataract. In the study of the endogenous calcium metabolism in cases of senile cataract, the patients were found to be responding normally to the factors influencing the calcium metabolism and were utilizing their calcium properly.

Regardless of these findings, Kirby [11] decided to employ parathyroid therapy in these cases. He therefore treated three series of patients with injections of an effective parathyroid extract; he obtained no improvement in the vision, refraction or the objective appearance of the cataracts of these patients.

CATARACTS OF ENDOCRINE ORIGIN

Siegrist [12] advanced the view of the endocrine origin of senile cataract. Löwenstein [13] stated the opinion that cataract caused by endocrine disturbances is more common than is generally assumed. He expressed the belief that such cataracts in young persons present a characteristic picture of subcapsular shieldlike opacities with arcade-shaped outlines. Against the view of the endocrine origin of cataract is the fact that treatment with the specific hormone fails.

Fischer-Galatz [14] stressed the importance of so-called "puberty cataract," which he said is often overlooked, as in many cases it does not interfere early with acuity of vision. This form of cataract appears only at puberty and is due to a deficiency of the interstitial glands. It can be seen only through the dilated pupil and is composed of small gray patches located in the cortex around the equator of the lens. Fischer-Galatz described the puberty cataract as identical with Vogt's coronary cataract and with the "blue cataract" described by earlier authors. It is always bilateral and familial, becomes denser during the sexual maturity of the patient and develops into complete opacity of the lens during older age, thereby indicating a hormonal deficiency of the glands at puberty. Patients with this condition were said to show signs of sexual impotence and an absence of the sexual desire. Hypoparathyroidism,

11. Kirby, D. B.: Senile Cataract: Use of Parathyroid Extract, Arch. Ophth. **5**:754 (May) 1931.

12. Siegrist, A.: Gray Senile Cataract: Its Causes and Non-Operative Treatment, Berlin, Urban & Schwarzenberg, 1928.

13. Löwenstein, A.: The Clinical and Histologic Picture of Cataract of Endocrine Gland Origin, Arch. f. Ophth. **132**:224 (April) 1934; abstr., Arch. Ophth. **13**:467 (March) 1935.

14. Fischer-Galatz, T.: Clinique, Paris **25**:119, 1930.

however, was not detected in them. The hormonal imbalance, because of a disturbance of the interstitial cells and consecutive acidosis, was said to cause an alteration in the lens. With definite and complete evolution of the glands at puberty the destructive process in the cells of the lens comes to an end. If the hormonal balance is not restored in the system during growth, the opacification of the lens will progress. Later, in old age, when the activity of the interstitial cells is naturally depressed, the cataract reaches its maximum.

CATARACTS DUE TO THE ROENTGEN RAYS AND HEAT

Cataracts resulting from exposure to the roentgen rays, radium, ultraviolet rays and infra-red rays have been the subject of considerable study. Peter [15] in 1930 produced permanent lenticular lesions of a posterior axial type of complicated cataract in rabbits by exposing them to 1 erythema dose of the roentgen rays. The opacities became visible one hundred and sixty-five days after exposure, so he concluded that it is necessary to wait five months before a certain dose of roentgen rays can be said to be harmless to the lens. The same was true for radium with the usual 0.5 mm. platinum iridium filter. The smallest dose used was 144 milligram element hours, which produced definite opacities in the lens after five and a half months. Axial portions of the cortex, which contain no nuclei, were apparently more sensitive to the roentgen rays and radium than any other part of the lens. The epithelium of the lens did not seem to be affected by the small doses of the roentgen rays. The cataracts due to the roentgen rays and radium differed from cataracts due to the infra-red rays in that they had a long period of latency.

So-called ray cataracts were said by H. Goldmann [16] to be due to absorption of the heat rays by the iris and their secondary conduction to the lens. Without an absorbing medium in front of it the lens would remain clear. Goldmann showed that the iris of rabbits absorbs about 98 per cent of the infra-red rays and explained that cataract in glass blowers is caused by continued exposure to heat rays which are absorbed by the iris and conducted to the lens. In later experiments, in 1933, Goldmann [17] measured the temperature behind the iris and lens and found that radiations from a furnace raises the temperature. If the radiations were filtered so that only infra-red rays acted on the eye the rise in temperature was slight. He concluded that the rôle played by penetrating infra-red rays was small in comparison with that of the heat

15. Peter, L.: Arch. f. Ophth. **125**:428, 1930.
16. Goldmann, H.: Arch. f. Ophth. **125**:313, 1930.
17. Goldmann, H.: Arch. f. Ophth. **130**:93, 1933.

waves and that a similar increase in temperature behind the iris must take place in laborers who work in front of furnaces. P. Scotti [18] also stated the opinion that the cataract of furnace workers is due to the heat of the rays. Meesmann [19] expressed the belief that the sclerosis of the nucleus and senile opacities in the lens are distinct symptoms of the biologic aging of the patient and senile destruction of the lens, which are factors forming a predisposition to the development of lesions resulting from work in front of furnaces. Vogt,[20] in 1933, after considerable research of his own and after studying the subject of furnace workers' cataract, concluded with Hirschberg, Birch-Hirschfeld, von Hess and others that furnace workers' cataract is a cataract caused by rays and not by heat. No rays of the spectrum except penetrating infra-red rays can produce cataract on absorption into the lens without damaging the cornea or iris. Vogt stated that heat emanating from the iris and affecting the lens cannot be adduced as an etiologic factor. Colloidal chemical changes of the albumin of the lens may have a causative effect in connection with short wave infra-red rays. The resemblance of the cataract to the axial type of cataract at the area where the rays strike the lens and the absence of any effect on the lids or other parts of the eyes of those afflicted with fire cataract support this view.

THE OXIDATION-REDUCTION MECHANISM

Goldschmidt found that the oxidation-reduction mechanism depended on the presence of a dialyzable thermolabile constituent, glutathione, and a thermostable constituent, beta crystallin. He also showed that methylthionine chloride could be reduced by the normal lens in the presence of cysteine. Because of its importance in the normal lens glutathione was studied quantatively by Adams,[21] Tassman and Karr,[22] Gifford,[23] Cordero [24] and Krause.[25] Adams found the amount in normal ox lens to be about 0.3 per cent of the whole weight of the lens. Tassman and Karr estimated that there is an average of 0.296 per cent of glutathione in the normal pig lens and found that it was entirely absent

18. Scotti, P.: Ann. di ottal. e clin. ocul. **58**:963 (Nov.) 1930; **59**:230 (March) 1931.

19. Meesmann, A.: Klin. Monatsbl. f. Augenh. **92**:289 (March) 1934.

20. Vogt, A.: Klin. Monatsbl. f. Augenh. **91**:721 (Dec.) 1933; **85**:32 (Sept.) 1930; **86**:289 and 295 (March) 1931; **91**:30 (July) 1933.

21. Adams, D. R.: Brit. J. Ophth. **14**:545 (Nov.) 1930.

22. Tassman, I. S., and Karr, W. G.: Glutathione in Crystalline Lens, Arch. Ophth. **2**:431 (Oct.) 1929.

23. Gifford, Harold, Jr.: Determination of Oxidation-Reduction Mechanism in Lens of Rabbits with Naphthalene Cataract, Arch. Ophth. **7**:763 (May) 1932.

24. Cordero, C.: Rassegna ital. d'ottal. **2**:69 (Jan.-Feb.) 1933.

25. Krause, Arlington: Chemistry of Lens: Composition of Albumoid and Alpha Crystallin, Arch. Ophth. **8**:166 (Aug.) 1932.

in the human lens with mature senile cataract. Harold Gifford Jr.[23] also showed that it was absent in human cataractous lenses, and in normal rabbit lenses he found the average amount of glutathione as expressed in percentage of weight of the lens to be 0.431. Krause [25] expressed the opinion that these estimates reported for glutathione in the normal lens were too high, since from his studies he was convinced the lens contained smaller quantities of the substance. However, it was agreed by most of the investigators that glutathione is essential to the normal oxidation-reduction mechanism of the lens, that it is present in a smaller quantity than normal in the lens with cataract and that it is almost entirely absent in the lens with mature cataract. This deficiency, however, was thought to be an accompanying factor in the formation of cataract and not an initial cause.

PERMEABILITY OF THE CAPSULE OF THE LENS

The permeability of the capsule of the lens is another factor which was considered of great importance in the development of cataract. Many stated the belief that an increase of the permeability of the capsule was largely responsible for cataract. It was explained that the increased permeability of the capsule was due to the effect of age on the colloidal membrane. Jonas Friedenwald,[26] however, showed conclusively that the permeability of the capsule of the lens decreases with age and also with increase in the molecular weight of the diffusing substances. Sanford Gifford and his co-workers [27] later also showed that the normal capsule of the lens is freely permeable to water, electrolytes and substances of fairly high molecular weight, but, like Friedenwald, they found that the permeability of the capsule decreases with age and that it is conceivable that this decrease could prevent sources of nutrition from reaching the lens and thus could hasten death of the fibers of the lens, with resulting cataract. They expressed the opinion that the results of their experiments also invalidated the assumption of Duke-Elder that variations in osmotic pressure or in hydrogen ion concentration were effective in producing cataract, for this was not found to be so in vitro, within a range much greater than that possible in life. Duke-Elder,[28] in describing the metabolism of the eye, spoke of four equilibriums, the third of which he defined as a delicate balance

26. Friedenwald, Jonas S.: Permeability of Lens Capsule, with Special Reference to Etiology of Senile Cataract, Arch. Ophth. **3**:182 (Feb.) 1930; Permeability of Lens Capsule to Water, Dextrose and Other Sugars, ibid. **4**:350 (Sept.) 1930.

27. Gifford, S. R.; Lebensohn, J. E., and Puntenny, I. S.: Biochemistry of Lens: Permeability of Capsule of Lens, Arch. Ophth. **8**:414 (Sept.) 1932.

28. Duke-Elder, W. S.: Metabolism of the Eye: Physiologic Aspects, Arch. Ophth. **6**:1 (July) 1931; Metabolism of the Eyes: Clinical Applications, ibid. **6**: 158 (Aug.) 1931.

between the intra-ocular fluid and the lens. The effects of disruption of the forces which maintain this equilibrium constitute one of the factors in the etiology of cataract.

SENSITIVITY TO LENS PROTEIN

Verhoeff and Lemoine in 1922 [29] described what they called endophthalmitis phaco-anaphalactica, in which they found that about 8 per cent of the patients tested by the intradermal injection of lens protein were sensitive to the substance. This was characterized by a local cutaneous reaction, and in the eyes of those patients affected after extraction of cataract these authors observed characteristic histologic changes. This was later confirmed by several other investigators but was contradicted by Roth. It was advised that these patients be desensitized to lens protein both before and after operation. Burky and Woods [30] prepared a lens extract for use in cutaneous tests. In seventy-five normal patients tested they obtained negative results, while in eleven patients with cataract they obtained positive results. When they found that rabbits could not be immunized to whole rabbit lens alone and that rabbits on which needling was repeatedly carried out produced no antibodies, they investigated, with Woodhall, the action of the individual purified crystallin in the homologous species, in 1933.[31] Their results suggested that alpha crystallin is a true organ-specific substance, is the same in all species and is present in all extracts of whole lens. Beta crystallin and gamma crystallin were considered as a complex and were inert in the homologous series. When combined with alpha crystalline in extract of whole lens they modified the antigenic properties so that in the homologous species those of alpha crystalline were inhibited. This suggested to the authors why in most cases the escape of lens substance through the ruptured capsule is not followed by the development of antibodies of an immune allergic type. Burky [32] in 1934 produced endophthalmitis phaco-anaphalactica experimentally in rabbits by intermediary action of staphylococcus toxin, which suggested that the sensitivity to lens in man in some instances at least is caused by the action of a toxin from a focus of infection or by the infection of the eye by toxin-forming bacteria at the time the lens matter is being absorbed after an operation.

---

29. Verhoeff, F. H., and Lemoine, A. N.: Internat. Cong. Ophth. **1**:234, 1922.

30. Burky, E. L., and Woods, Alan C.: Lens Extract: Its Preparation and Clinical Use, Arch. Ophth. **6**:489 (Oct.) 1931.

31. Burky, E. L.; Woods, A. C., and Woodhall, M. B.: Organ Specific Properties and Antigenic Power in Homologous Species of Alpha Crystallin. Arch. Ophth. **9**:446 (March) 1933.

32. Burky, E. L.: Experimental Endophthalmitis Phaco-Anaphylactica in Rabbits, Arch. Ophth. **12**:536 (Oct.) 1934.

DIETARY DEFICIENCY AND THE FORMATION OF CATARACT

During the past five years an enormous amount has been published in the literature concerning the relationship of vitamin deficiency to the development of cataract. Cataracts were produced in rats fed on a diet deficient in vitamin G by Day, Langston and O'Brien [33] and later in albino mice my Langston, Day and Cosgrove.[34]

Mature cataracts developed bilaterally in ten days in 68 per cent of rats which were fed a diet by Mitchell and Dodge in which lactose was the sole carbohydrate and constituted 70 per cent of the ration.[35] Definite cataractous changes were also found in the remainder of the rats. Control animals fed starch, maltose, dextrose or sucrose as the sole carbohydrate failed to show lenticular changes.

Later H. S. Mitchell reported the production of cataract in rats fed a diet of galactose. Yudkin and Arnold [36] also produced lenticular changes in albino mice which were fed a diet of 70 per cent lactose for from seventy to ninety days. With a diet of 50 per cent galactose these authors produced cataract in from eleven to fourteen days. In all these animals the nucleus showed the opacity first. With older animals which were fed a diet containing 50 per cent galactose, opacities in the lens appeared in about twenty-one days. In five weeks two of the animals showed definite mature cataracts. In contrast to the younger rats, the older animals showed cortical cataracts.

In commenting on the relationship between galactose or lactose and calcium, Yudkin and Arnold suggested that the presence of these sugars in the intestines may increase the absorption of calcium so that there would not be enough of this element present to combine with foreign substances which might have a toxic effect on the lens when absorbed. It was also mentioned that, aside from the possible effects of these sugars on the calcium metabolism, there is a possibility that the ocular lesion is the result of direct injury because of the presence of a considerable amount of lactose and galactose in the aqueous. The latter view was maintained by Mitchell, who suggested that galactose finds its way into the aqueous and alters the permeability of the capsule of the lens, thereby disturbing the existing normal ionic equilibrium.

---

33. Day, P. L.; Langston, W. C., and O'Brien, C. S.: Am. J. Ophth. **14**: 1005 (Oct.) 1931.

34. Langston, W. C.; Day, P. L., and Cosgrove, K. W.: Cataract in Albino Mouse Resulting from Deficiency of Vitamin G (B_2), Arch. Ophth. **10**:508 (Oct.) 1933.

35. Mitchell, H. S., and Dodge, W. M.: J. Nutrition **9**:37 (Jan.) 1935.

36. Yudkin, A. M., and Arnold, Caroline: Cataracts Produced in Albino Rats on Ration Containing High Proportion of Lactose or Galactose, Arch. Ophth. **14**: 960 (Dec.) 1935.

VITAMIN C DEFICIENCY

During the past two years vitamin C has received a great deal of attention and has been shown to bear considerable relationship to the formation of cataract. Vitamin C, or cevitamic acid, has been shown to be present in considerable quantity in the normal lens. In 1933 von Euler and Martius [37] showed that cevitamic acid reduced methylthionine chloride and all other substances reduced by glutathione and cysteine, and was formerly included in the estimations of these substances in the normal lens. These authors were able to estimate the amount of cevitamic acid independently at p_H 2.5 and revealed that about one fifth of the total reduction power of the bovine lens was due to vitamin C. They examined two clear human lenses from a man 30 years of age and found that the cevitamic acid accounted for 28 per cent of its power of reduction. It was significant that no vitamin C was found in the cataractous lens. At the same time Birch and Dann [38] stated that cevitamic acid has always been previously estimated as glutathione in the iodine titration. They suggested that the two may be linked factors in one system of oxidation in the animal cell. The vitamin C content of the lens was investigated also by Nordmann and van Wien,[39] Monjukowa and Fradkin,[40] Müller and Buschke [41] and others.[42] All agreed that vitamin C decreases in amount with age and is considerably reduced in quantity or nearly absent in a lens with cataract.

H. K. Müller [43] found that on feeding naphthalene to rabbits an acceleration in the oxidation of vitamin C in the aqueous took place. By the administration of large doses of cevitamic acid intravenously he was able to prevent the action of naphthalene in causing an increase in this rate of oxidation.

Bellows,[44] who, like others, found that the quantity of vitamin C was greatly reduced or entirely absent in the lens and aqueous of

37. von Euler, H., and Martius, C.: Ztschr. f. physiol. Chem. **222**:64, 1933.

38. Birch, W., and Dann, J. W.: Nature, London **131**:469, 1933.

39. Nordmann, J., and van Wien, H.: Bull. Soc. d'opht. de Paris, March 1934, p. 136.

40. Monjukowa, N. K., and Fradkin, M. J.: Arch. f. Ophth. **133**:328 (Jan.) 378 (Feb.) 1935.

41. Müller, H. K., and Buschke, W.: Arch. f. Augenh. **108**:368, 1934

42. Goldmann, H., and Buschke, W.: Arch. f. Augenh. **109**:205, 1935. Campbell, D. A.: Brit. J. Ophth. **20**:33 (Jan.) 1936. Nakamura, B., and Nakamura, O.: Arch. f. Ophth. **134**:197 (Aug.) 1935. Müller, H. K.: Arch. f. Augenh. **109**:434, 1935. Weinstein, P.: ibid. **109**:221, 1935. Gurewitsch, A.: ibid. **108**:572, 1934.

43. Müller, H. K.: Arch. f. Augenh. **109**:304, 1935.

44. Bellows, J.: The Biochemistry of the Lens: The Origin of Pigment in the Lens, Arch. Ophth. **14**:99 (July) 1935; Biochemistry of the Lens: Cevitamic

(Footnote continued on next page)

cataractous eyes, carried out a great many experiments to study the relationship of vitamin C to the formation of cataract. He found that the concentration of vitamin C in the blood of patients with cataract was less than in normal persons. A larger quantity of vitamin C had to be ingested by patients with cataract than by normal persons in order to cause an increase in the content of vitamin C in the blood plasma. He concluded that the reduction in the quantity of vitamin C in the aqueous and lens of cataractous eyes precedes the development of the opacities and is not secondary to it. He also demonstrated that cevitamic acid could be absorbed from the conjunctival sac of a rabbit through the cornea. Returning to the problem of galactose cataract, Bellows attempted to ascertain whether an excess of vitamin C or cystine in the diet would delay or prevent cataract in rats fed on galactose and also whether a decrease in the amount of vitamin C and of cysteine occurs in the lens before the onset of opacities. The result of these experiments showed that the onset of cataract in rats on a galactose diet seems to be somewhat delayed by the intraperitoneal injection of large doses of vitamin C. This was even more clearly demonstrated by the results of the administration of yeast in these cases. In order to prove that the effect of yeast was due to the SH content (cysteine), or to some other factor, Bellows added a small excess of cysteine to a diet rich in galactose and found that the onset of cataract was delayed as compared with the onset in control rats. This indicated that the sulfhydryls in the crystalline lens are lost or destroyed by the presence of galactose and that feeding an excess of these substances results in delay of the death of the fibers of the lens, either because they are replaced or because they are spared. Bellows' next step was to prove further a diminution in the amount of sulfhydryls or of vitamin C in the lens before the appearance of the opacities. Since it was demonstrated that feeding an excess of these substances results in delay of the onset of opacities, he reasoned that if it could also be shown that they diminish in amount before the opacities appear it would be reasonably certain that the loss of these substances is responsible for the formation of cataract. In rats fed on a galactose diet the lenses at the end of three and six days, before any opacities were visible, showed a reduction in the quantity of sulfhydryls —glutathione and cysteine. Since vitamin C was also found to delay the onset of cataract to some degree, Bellows thought the sulfhydryls and vitamin C were interchangeable in carrying out oxidation reduction

---

Acid Content of the Blood and Urine of Subjects with Senile Cataract, ibid. **15**:78 (Jan.) 1936; Biochemistry of the Lens: Some Studies on Vitamin C and Lens, ibid. **16**:58 (July) 1936. Bellows, J., and Rosner, L.: Biochemistry of the Lens: A New Proof of the Presence of Vitamin C in the Crystalline Lens, ibid. **16**:248 (Aug.) 1936.

in the lens and that as the SH content diminishes, vitamin C, if available, will take over more of this function and keep the lens more or less viable for a time. It was therefore plausible to assume that in man senile cataract could arise similarly, as a result of a sudden or gradual loss of cysteine from the lens which is called on to detoxify various substances, while at the same time there is an insufficient replacement of vitamin C.

In December 1936 Bellows and Rosner [45] published the results of the preparation of a substance from the crystalline lens of beef eyes which was considered to be glutathione. Up to this time glutathione had not been isolated from the lens in pure form. They obtained 0.2 Gm. from two hundred beef lenses.

---

45. Bellows, J., and Rosner, L.: Biochemistry of the Lens: Preparation of Glutathione from Crystalline Lens, Arch. Ophth. **16**:1001 (Dec.) 1936.

News and Notes

EDITED BY W. L. BENEDICT

UNIVERSITY NEWS

Intensive Post-Graduate Course in Ophthalmology at George Washington University School of Medicine.—The second annual post-graduate course in ophthalmology, given under the auspices of the George Washington University School of Medicine, in Washington, D. C., will be held from April 18 to 23, 1938. According to the preliminary announcement there will be eighteen guest lecturers in addition to the members of the resident staff, who will lecture on clinical subjects. A course in histopathology of the eye by Lt.-Col. J. E. Ash, M.C., U.S.A., Lt.-Col. Frederic H. Thorne, M.C., U.S.A., and Capt. Elbert DeCoursey, M.C., U.S.A., of the Army Medical Museum, is included in the program The fee for this course will be $40.

In addition to the regular course mentioned here, a course will be given by the members of the resident staff from April 15 to 17 inclusive. The attendance will be limited to twenty participants. The fee for this course will be $25, and the names will be filed in order of reception.

The following program for this last named course has been announced as follows:

1. Operations on the eyes of cadavers and of animals, accompanied with illustrated short talks on the operations to be considered.

2. "Ocular Pathology at the Army Medical Museum," by Lt.-Col. J. E. Ash, M.C., U.S.A., Lt.-Col. Frederic H. Thorne, M.C., U.S.A., and Capt. Elbert DeCoursey, M.C., U.S.A.

3. A practical course in the technic of orthoptic training, with short talks on the application of the knowledge of the subject.

Further details may be obtained by writing to the secretary, Miss Louisa G. Wells, 927 Seventeenth Street, N.W., Washington, D. C.

SOCIETY NEWS

Scientific Meeting of the Eye Section of the Philadelphia County Medical Society.—At the meeting of the Eye Section of the Philadelphia County Medical Society held at the Wills Hospital on Dec. 2, 1937, Dr. Thomas Cowan reported a case of bilateral macular coloboma, Dr. Robb McDonald reported cases from the Wills Hospital, Dr. Karl Kornblum gave a lantern demonstration on the "Roentgenologic Aspects of Exophthalmos" and Dr. Gustav Bucky, of New York, gave a lantern demonstration on "Roentgen Versus Grenz Ray Therapy in External Diseases of the Eye."

Treacher Collins Prize.—The council of the Ophthalmological Society of the United Kingdom has instituted a prize of £100 to be awarded triennially for the best essay submitted on a subject selected by the council. This is to be called the Treacher Collins Prize.

The prize is open to qualified medical practitioners of any nationality, but the essay must be written in the English language. The subject for the first award of the prize is "Cerebrospinal Disease and Its Relation to the Optic Nerve."

The closing date for sending in essays for the first award is Dec. 31, 1938. They should be submitted to the honorary secretary, Ophthalmological Society of the United Kingdom, 5 Racquet Court, Fleet Street, E.C.4, from whom also any further particulars can be obtained.

Ophthalmological Society of the United Kingdom.—The annual congress of the Ophthalmological Society of the United Kingdom will be held in London on April 28 to 30, 1938.

The subject for discussion will be: "The Differential Diagnosis of the Causes of Exophthalmos." Mr. R. Foster Moore will consider the ophthalmologic aspects; Mr. T. E. Cawthorne, the otolaryngologic aspects, and Dr. W. Russell Brain, the medical and neurologic aspects.

The annual dinner of the society will be held on Thursday, April 28.

CORRECTION

In the review of Gifford's "Handbook of Ocular Therapeutics," published in the September 1937 issue (ARCH. OPHTH **18:** 490, 1937), the title was given as "Ocular Therapeutics" and the price given as $3.25 instead of $3.75.

Obituaries

WILLIAM LANG

1863-1937

William Lang died on July 13, 1937, at the age of 84. He received his medical education at the London Hospital and was appointed surgeon to the Royal London Ophthalmic Hospital in 1884. He was particularly interested in the diagnosis and treatment of diseases of the eye and was a pioneer in the conception of focal sepsis, as he was one of the first to recognize that iritis had its origin in a focus of inflammation elsewhere in the body.

He was one of the original members of the Ophthalmological Society of the United Kingdom, and many of his articles appeared in the *Transactions of the Ophthalmological Society of the United Kingdom.*

Though handicapped by a marked tremor of the hands, he was a skilful operator and suggested a number of useful instruments, such as a speculum with a device to guard the lashes, two knives to divide anterior adhesions, a lacrimal syringe, a blunt dissector and a scoop. He suggested the insertion of an artificial globe in Tenon's capsule after enucleation.

Lang was a splendid teacher, a hard and conscientious worker and a keen observer. His work was characterized by complete attention to detail, which assured him great success in practice.

His son, Basil, a capable and brilliant ophthalmologist, died at the early age of 47, a few years after being elected to the staff of Moorfields.[1]

ARNOLD KNAPP.

1. Lawson, Arnold, cited in Obituary of William Lang, Brit. M. J. **2**:189 (July 24) 1937.

PAUL ROEMER

1873-1937

Roemer's early training was different from that of other ophthalmologists as he studied bacteriology with Gaffky and serology with Ehrlich at a time when these new branches of scientific medicine were coming into their own. This unusual preparation opened up for him many new fields in ophthalmology. He was the first to introduce immunologic and bacteriologic investigations into the study of ophthalmologic problems.

Roemer's training in ophthalmology began with Vossius in Giessen from 1897 to 1899 and was continued with Hess in Würzburg from 1901 to 1907. He was appointed to a full professorship in ophthalmology in Greifswald at the early age of 33, where he continued his brilliant investigations. In 1921 he received the ophthalmic appointment in Bonn; he remained here until his death.

His bacteriologic studies were on botulism, bacteria of the conjunctival sac, the varying virulence of pneumococci and the transference of trachoma to animals. His serologic investigations were more important and consisted of studies on the immunity of the aqueous, cornea and vitreous, organ specificity of lens albumin, anaphylaxis of lens albumin, the development of senile cataract, the pathogenesis of sympathetic ophthalmia and immunity to abrin in the treatment of trachoma with jequirity.

Roemer was a man of unusual originality of thought, a true research worker. His investigations were always subjects of importance in the prophylaxis or treatment of diseases of the eye and were carried out with the greatest industry.

ARNOLD KNAPP.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

HISTOLOGIC SIGNIFICANCE OF THE CAPSULE OF TENON. J. MAWAS, Bull. Soc. d'opht. de Paris, February 1937, p. 110.

Contradictory statements have been made from both a clinical and an anatomic standpoint concerning the ocular aponeurosis. Mawas believes that the greatest difficulty has been due to faulty technic of anatomic studies. After many trials he has evolved the following technic, which apparently avoids confusion: The entire orbit is fixed in a 4 per cent solution of formaldehyde or in Bouin's solution, set in pyroxylin (celloidin) for several months and decalcified in dilute nitric acid colored with a compound of hematin and trinitrophenol, which gives a poppy color to the capsule of Tenon. To obtain an exact idea of the capsule of Tenon it should not be studied as an isolated part, as was done by the anatomist whose name is attached to this membrane. A better method is to connect this study with that of the orbital conjunctiva and other organs of the orbit. In the orbit is a system of partitions formed by conjunctival fibers. This system separates the organs in the orbital cavity and at the same time maintains solidity by periosteal fibers. There is nothing to justify the classic conception of an isolated or separate membrane or capsule. Around the sclera the conjunctival tissue is condensed, and it is intimately adherent to the sclera. Two excellent photomicrographs accompany the article.

L. L. MAYER.

HETEROTOPIC TRANSPLANTATION OF THE OPTIC VESICLES. J. SZEPSENWOL, Compt. rend. Soc. de biol. **125**: 609, 1937.

In the axolotl (the larval form of the salamander, Ambystoma punctatum) the optic vesicle was transplanted at the site of a previously amputated ear or anterior limb. When the vesicle has the typical orientation (with the lens toward the exterior), characteristic development and differentiation result. Normal form is attained, and the nerve fibers of the retina organize at the disk to form the optic nerve. In atypical orientation, however, development is defective; the eye attains but a quarter of its normal volume, and the elements are hardly differentiated. Contact with the external environment is hence essential for differentiation and the development of nerves.

The optic nerve has a definite affinity for the anterior portion of the brain and will not attach to any other part of the cerebrum, and the presence of the optic vesicle does not affect the course of neighboring cranial or brachial nerves. From the latter, however, sympathetic fibers detach to contact the pigmentary membrane. These fibers arise from a ganglionic mass in intimate relation with the brachial plexus.

J. E. LEBENSOHN.

Biochemistry

THE WATER-BINDING OF THE BRAIN. J. A. VAN HEUVEN and P. F. FISCHER, Brit. J. Ophth. **21:** 352 (July) 1937.

From a series of experiments the authors concluded that the white and the gray matter of the brain are capable of binding water and that this water binding is a real *Quellung*.

The capacity for water binding is considerable; it is greater in the white matter than in the gray matter, and the capacity of the white matter of the brain is almost equal to that of the optic nerve. One might say that in these experiments the relation between the optic nerve and the white matter of the brain is once more shown.

W. ZENTMAYER.

Conjunctiva

CONJUNCTIVAL PEMPHIGUS. M. H. WHITING, Brit. J. Ophth. **21:** 529 (Oct.) 1937.

The case is of interest because of the beneficial effect of the wearing of a contact glass filled with liquid paraffin. In the right eye this was possible without operative intervention, but in the left eye a lower fornix was first made with a mucous membrane graft from the lip. In the right eye vision improved from ability to count fingers at 1 meter to 6/24 or better, and in the left eye from perception of movements of the hand to 6/60, in three months.

W. ZENTMAYER.

ESSENTIAL ATROPHY OF THE CONJUNCTIVA. E. CUSTODIS, Arch. f. Ophth. **137:** 364 (Aug.) 1937.

In 1870 von Stellwag described a disease characterized by apparently primary cicatricial shrinkage and shortening of the entire conjunctiva of each eye. Stellwag named the disease degenerative syndesmitis, whereas von Kries, who observed a similar condition in von Graefe's clinic, introduced the term essential shrinkage, or atrophy, of the conjunctiva. In the years following these two original publications it became almost a general belief that syndesmitis degenerativa was identical with pemphigus.

Custodis has observed and thoroughly studied for seven years one case of what he considers to be true essential atrophy of the conjunctiva. At no time during this period did the patient (an elderly obese woman with mild compensated hypertension, low values for hydrochloric acid in the gastric juice and chronic constipation) show any signs of bullous dermatitis or of vesicular lesions on any of the mucous membranes. The author therefore believes that "essential atrophy of the conjunctiva is a disease by itself which has no relations to the chronic pemphigus of the skin. Essential atrophy of the conjunctiva may go on for years and may or may not be accompanied by manifestations (nonvesicular) on other mucous membranes (mouth, pharynx, larynx). Pathologically, a chronic inflammation prevails in the subepithelial tissue of the conjunctiva, which is followed by hypertrophy of the connective tissue. The tissues of the orbit take part in this chronic inflammation." (In Cus-

todis' case enucleation of one eye became necessary. Because of the small amount of conjunctiva the author performed incomplete exenteration of the orbit.) "During the chronic inflammation and the subsequent shortening of the conjunctiva, vesicle-like structures develop on the surface of the conjunctiva; these are, however, not real vesicles but merely retention cysts developing from accessory lacrimal glands the ducts of which have been blocked by the shrinkage of the conjunctiva. . . . Essential atrophy of the conjunctiva is due to damage done to the subepithelial connective tissue of the eye and other structures by toxins liberated in the alimentary canal. The liberation of toxins has its cause in an endocrine disturbance." The author believes that the measures instituted by him to normalize the function of the bowels (the administration of pepsin and hydrochloric acid by mouth, charcoal and purgatives whenever needed and estrogenic substance) checked the progression of the disease in one eye.

P. C. KRONFELD.

Comparative Ophthalmology

BIOLOGIC STUDY OF THE RETINA OF THE VERTEBRATES. M. L. VERRIER, Arch. d'opht. **53:** 281 (April); 363 (May) 1936.

This study covers a large number of vertebrate retinas and is illustrated with drawings depicting the great variations found in the rods and cones. One conclusion that the author comes to is that there is an infinite variety of these cells. They can be correlated with the two types of cells, rods and cones, in certain instances, but there are many intermediate types. As the fovea is approached, there is a reduction in the size and height of the visual cells, the droplets of oil becoming more and more indistinct. The visual purple and droplets of oil are not confined to the rods and the cones, respectively. The variation in the form of the visual cells is one of the effects of light. The more or less exclusive occurrence of cones in diurnal animals and of rods in nocturnal animals is not a strict general rule. From the point of view of the dualistic theory of vision, a great deal more work must be done. A microchemical study under varying conditions of illumination, a study of the p_H of the retina and an investigation of the retinal currents might yield valuable information. By such observations alone will it be possible to correlate the form and function of the visual cells.

S. B. MARLOW.

Cornea and Sclera

KERATOPLASTY. R. E. WRIGHT, Brit. M. J. **1:** 1311 (June 26) 1937.

Wright has developed a simple technic for keratoplasty. A 6 mm. trephine is most useful although a corkborer is almost equally good. No other special instrument is required. A normal anterior chamber is of advantage for the eye receiving the graft. Good grafts can be obtained from eyes blind from glaucoma as well as from those removed because of malignant disease. The recipient's pupil should be small and the donor's large, if possible. Akinesia and anesthesia are established in the usual way.

Preparation for Transplantation.—The site is demarcated on the recipient's cornea by a few rotations of the trephine. Three sutures are placed in the conjunctiva, just off the cornea, in the following manner: from 6 to 12 o'clock, from 7:30 to 1:30 o'clock and from 9:30 to 4:30 o'clock, the free ends being carried back across the cornea to 6, 7:30 and 9:30 o'clock, respectively. The stitches are then pulled free from the demarcated area and the lids closed temporarily.

Trephining the Donor.—In this operation the same trephine is used in a corresponding position on the cornea. Good fixation of the globe is desirable. The disk should be cut away clean as far as possible. Usually a short hinge is left, consisting of a narrow belt of Descemet's membrane, which is cut free with fine, sharp scissors. If a Graefe knife is used it must be plunged deep into the eye and the hinge cut as the knife is withdrawn. The severed disk is received, epithelium side down, on a Volkmann spoon, with the help of a camel's-hair brush, and then placed in isotonic saline solution of a temperature of about 38 C.

Trephining the Recipient.—Great caution is necessary in this operation. One trephines through the cornea as far as possible and then tilts the trephine; the tilting is followed by the escape of aqueous. The hinge will be much larger in this case, often two thirds the circumference of the circle. The disk can be seized with a forceps and the hinge severed at the correct level with either scissors or a knife. A little sterile saline solution is now allowed to flow into the anterior chamber.

The Transplantation.—The graft is lifted with the Volkmann spoon and the camel's-hair brush from the warm saline solution, tumbled into the aperture, and adjusted to its new position by a few touches of the brush. The sutures are then replaced over it in the proper order and tied with the aid of a forceps. Atropine sulfate and iodoform ointment are placed in the conjunctival sac, and both eyes are bandaged.

The patient is kept somewhat quieter than a patient with cataract. The eye is dressed on the third day after the operation, at which time the anterior chamber is usually formed. The sutures are removed on the fifth day, and the instillation of atropine sulfate is continued. On the eighth day the patient is allowed up, and dark glasses are given. The formation of anterior synechiae are to be avoided by all measures at the surgeon's command.

W. F. DUGGAN.

THREE NEW CASES OF DISCIFORM BLOOD STAINING OF THE CORNEA. P. TOULANT and G. MORARD, Arch. d'opht. **53:** 241 (April) 1936.

Toulant and Morard carefully observed three cases of blood staining of the cornea from the onset and have been able to study the genesis of this condition with the slit lamp from the very beginning. In all the cases the condition was of traumatic origin. The injury produced hyphemia in the anterior chamber and simultaneously total massive hematoma of the cornea. With the slit lamp it was possible to differentiate only the epithelium of the cornea, as the beam of light penetrated no deeper. It appeared as though the intralamellar spaces were filled with red cells. After a period of from five to nine days a more refringent ring appeared about 2 mm. from the limbus, a sort of condensation ring. Twenty-four

hours later the cornea outside this ring began to clear, the central portion becoming more uniform, obliterating the inner rim of the ring to form the characteristic discoid opacity. This opacity has been reported to last from two months to two years. The authors do not concur in the idea that the condition is a hematic impregnation, because hyphemia and corneal infiltration occur at the same time. They lean to the opinion that it is a true intracorneal hematoma. Its pathogenesis is still in doubt. They believe that its occurrence is independent of hyphemia, changes in the blood and hypertension. In one of the cases hypotension was present. Some experimental work is in progress to attempt to solve this problem by histologic study.

S. B. MARLOW.

CULTURE OF PRESERVED CORNEAL TISSUE. M. A. BAJENOVA, Arch. d'opht. **53:** 300 (April) 1936.

Bajenova was able to grow adult rabbit cornea in Carrel mediums. Corneal tissue preserved for ten days at a temperature of —2 C. is capable of growing and preserving its vitality. The elements that grow on culture are the epithelium and the fibrocytes. The preserved cornea grew as well as fresh cornea, the growth differing in neither quality nor quantity.

S. B. MARLOW.

THERAPY OF INTERSTITIAL KERATITIS: TWELVE YEARS' OBSERVATION IN THE DNEPROPETROVSK EYE CLINIC. A. G. KROL, Vestnik oftal. **10:** 696, 1937.

The mode of antisyphilitic treatment of interstitial keratitis in the clinic has been as follows: 1. Injections of a solution of mercury instead of injections of neoarsphenamine are given at first, in order to avoid a biotropic reaction; then arsenicals are given, which are followed by injections of bismuth and iodine preparations. 2. Large doses of any medication applied are given. 3. General hygienic measures, such as exposure to sunshine, good nourishment, treatment with the quartz mercury vapor lamp, injections of milk and hot applications, are carried out.

Two hundred and forty-four hospital patients were treated during 1923 to 1935. From 1926 the combined therapy only (mercury, neoarsphenamine, bismuth and iodine, in the order named) was applied. A comparative study was made as to the results obtained from the treatment with one type of medication or with the combined therapy (the results are shown in four tables).

From the results obtained in his extensive experience during many years Krol concludes that combined antisyphilitic therapy has a definitely favorable influence on the course of parenchymatous keratitis, no recurrence being noted. When recurrence does occur, it is a result of insufficient or no treatment. The earlier the treatment is begun, the better the results are; before the age of 15 years the disease seems to run a more favorable course. Krol uses atropine iontophoresis in those cases in which solution of atropine sulfate fails to break down the posterior synechia and to dilate the pupil.

O. SITCHEVSKA.

General Diseases

Ocular Lesion Associated with Postoperative and Gestational Nutritional Deficiency. H. P. Wagener and J. F. Weir, Am. J. Ophth. **20:** 253 (March) 1937.

Wagener and Weir discuss avitaminosis briefly and report several cases. They give the following summary:

"It seems probable that acute optic neuritis, hemorrhages in the retina, paralyses of ocular muscles, and nystagmus may be caused by dietary or nutritional deficiencies. These deficiencies may develop rather rapidly, especialy in the presence of persistent vomiting and the resultant lack of absorption of food."

W. S. Reese.

Visual Sequelae from Epidemic Meningococcus Meningitis. P. Heath, Am. J. Ophth. **20:** 401 (April) 1937.

A study was made to determine clinical residue persisting in epidemic meningococcic infection, especially relating to the visual system, and to compare these findings with other complications, particularly aural. A complete summary of the medical, neurologic, ophthalmic and otologic examinations of sixty-eight patients selected because of a high proportion of complications is given.

W. S. Reese.

Oculoglandular Tularemia. F. A. Hamburger, Arch. f. Ophth. **137:** 419 (Aug.) 1937.

In the fall of 1936 an epidemic of tularemia was observed in the northeast part of lower Austria. Persons were infected through skinning infected wild hares or by eating their meat. About seventy cases of the polyglandular form and five cases of the oculoglandular form were reported to the health authorities. Hamburger made thorough studies of three patients with the oculoglandular type who were admitted to Lindner's clinic. The severity of the conjunctival changes varied. With the exception of the severest forms, which resembled tuberculosis of the conjunctiva, the clinical picture of ocular tularemia was that of Parinaud's conjunctivitis. In cases in which the condition is questionable the diagnosis can be made certain by the agglutination test. The bone marrow of the sternum was found, by inoculation into guinea pigs, to contain the bacillus. Excellent drawings in colors accompany the paper.

P. C. Kronfeld.

General Pathology

Further Contributions to Ocular Changes in Besnier-Boeck's Disease. R. Seefelder, Arch. f. Augenh. **110:** 415, 1937.

Seefelder describes a case of Besnier-Boeck's disease (Boeck's sarcoid) involving the conjunctival folds. The condition was characterized by follicle formation and small lumps in the conjunctiva. The microscopic changes in the conjunctival follicles corresponded fully to the changes noted in the skin and other organs in this disease. A new observation that the author was able to demonstrate was layer-like calcium concretions in the numerous giant cells present in the follicles.

This picture has apparently been seen heretofore only in tuberculous changes. This fact merits attention in regard to the question of the etiology of the disease.

E. G. SMITH.

CONSTELLATION PATHOLOGY AND OPHTHALMOLOGY. J. STREBEL, Klin. Monatsbl. f. Augenh. **97:** 777 (Dec.) 1936.

Strebel discusses and analyzes the problem of so-called constellation pathology in ophthalmology. It was the topic of a paper by H. Piesbergen (*Klin. Monatsbl. f. Augenh.* **93:** 765 [Dec.] 1934; abstr., ARCH. OPHTH. **14:** 840 [Nov.] 1935). Strebel adds a number of data from the medical, general and philosophic literature, referring to Aristotle, Leibnitz, Bohr, Kant, Heisenberg, Planck, Kirchhoff and others. He suggests replacing the term constellation pathology with coefficient equation, which term he used in 1915. Great importance is attributed to the causal law, which wrongly has been declared obsolete by some representatives of "atom physics." Strebel stresses the mathematical basis of these considerations and presents his own complicated mathematical equations. He reasons that the constellation of pathologic factors which lead to ocular and other diseases is subject to mathematical laws analogous to the laws governing the various forms of crystals and minerals. Referring to other publications in point, Strebel mentions the discussion "Is the Causal Law Applicable to the Psychic Realm?" by Alfred E. Hoche, professor emeritus of psychiatry at the University of Freiburg, Germany (Hoche, Alfred E.: Aus der Werkstatt, Munich, J. F. Lehmann, 1935, p. 101).

K. L. STOLL.

Glaucoma

EXTRA-OCULAR INFLUENCE IN GLAUCOMA (CONSTITUTIONAL FACTORS). F. MASSOUD, Brit. J. Ophth. **21:** 559 (Oct.) 1937.

Massoud recounts the changes found in the circulatory, nervous and endocrine organs in association with glaucoma, as culled from the literature and from his own investigations. He states that on analyzing these findings one cannot fail to see their clear indication of the presence of a toxin or toxins in the body in cases of glaucoma, which constitute the origin of all these changes—their effect on the blood causing its diminished calcium content and other changes; their effect on the blood-forming tissues producing new cellular formation of large mononuclears and other alterations; their effect on the endothelial lining of the capillaries causing increased permeability, and, lastly, their effect on the sympathetic and endocrine systems producing the different states of derangement.

The extra-ocular influences in glaucoma indicate the line of treatment: rest in bed; a restricted diet; free intestinal, cutaneous and renal elimination; the intravenous injection of hypertonic solutions of sodium chloride or concentrated dextrose solution; the occasional use of epinephrine, an alkaloid preparation of ergot, or insulin, and irradiation of the body and of the thyroid.

The increase in the large mononuclear cells of the blood pointed out by the author in conjunction with other early signs may help in the diagnosis of suspected glaucoma.

W. ZENTMAYER.

Lacrimal Apparatus

TECHNIC AND RESULTS OF DACROCYSTORHINOSTOMY. H. WEVE and S. K. KENTGENS, Klin. Monatsbl. f. Augenh. **98:** 195 (Feb.) 1937.

Weve and Kentgens describe in detail the dacryocystorhinostomy performed after Dupuy-Dutemps' method and discuss the preparation, the anesthesia and the instruments. They point out the superiority of this method of suturing the mucous lining to other methods. Postoperative hemorrhage occurred very rarely. In case of postoperative hemorrhage the wound is reopened, and a strip of vioform gauze is inserted through it, but under no condition is insertion made through the nose. The gauze may be removed after forty-eight hours. This operation was performed on children and infants. Passage through the lacrimal canal was obtained within ten days prior to extraction of cataract and other intra-ocular operations. Intrabulbar operations should never be done prior to six weeks after recovery from dacryophlegmon. A fistula should not induce the operator to incise at any but the customary places, because the fistula will heal spontaneously. In tuberculosis of the tear sac, which is rare in Netherlands, extirpation is preferable; when this was followed by roentgen ray treatment healing occurred promptly in the four patients observed and operated on. The presence of swollen preauricular and submaxillary glands facilitates the diagnosis.

In the second part of the paper the authors render an account of the results of dacryocystorhinostomy with suturing of the mucous lining after the method of Dupuy-Dutemps and without suturing after the method of Toti; the former method was employed in 236 cases, and the latter in 129 cases, between January 1934 and September 1936. Perfect functional results were obtained in 97 per cent of the cases of dacryocystitis in which the method of Dupuy-Dutemps was used and in 90 per cent of the cases in which Toti's method was used. The percentage of cures in dacryostenosis was 82 with Dupuy-Dutemps's method and 70 with Toti's method.

K. L. STOLL.

Lens

CORRELATION BETWEEN THE CHANGES IN THE VITREOUS AND THE END-RESULTS OF INTRACAPSULAR EXTRACTION OF CATARACT. E. A. CHURGINA, Vestnik oftal. **10:** 653, 1937.

A thorough analysis and review of the literature on the causes of prolapse of the vitreous and of the retinal detachment following this is given by Churgina. She studied the anatomic relationship between the posterior capsule of the lens and the anterior hyaloid membrane of the vitreous after having removed the anterior segment of the human enucleated eye. Forty-five hernias of the vitreous (into the anterior chamber) were studied by the slit lamp; some were found to be primary, while the others were secondary or complicated, occurring as a result of injury to the hyaloid membrane. Two colored drawings illustrate a case of secondary hernia of the vitreous which appeared as a bulging mass in the chamber as the result of synechia between the iris and the vitreous, which had been broken down by atropine

sulfate. The histories of six patients in whom detachment of the retina occurred as a result of prolapse or hernia of the vitreous are reported.

Churgina draws the following conclusions:

1. The cause of frequent prolapse of the vitreous lies in the method of the operation.

2. Secondary hernia of the vitreous can occur either during the operation or at a much later period.

3. Pigment in the vitreous, cellular elements, and roughening of the hyaloid membrane are the result of irritation of the ciliary body and of low grade cyclitis.

4. Both prolapse and hernia of the vitreous may cause retinal detachment immediately after the operation or at a remote period.

O. SITCHEVSKA.

Methods of Examination

MAGNIFICATION OF THE IMAGE OBTAINED BY DIRECT OPHTHALMOSCOPIC EXAMINATION. H. LAUBER, Arch. f. Ophth. **137:** 434 (Aug.) 1937.

The magnification of the image obtained through direct ophthalmoscopic examination depends on the distance between the observer and the plane into which he projects the image that he has perceived. Since he has perceived that image without the use of his accommodation, one would, a priori, expect that this distance would vary greatly, because there can be no accurate judgment of distance under the conditions of monocular direct ophthalmoscopy. Actually, the amount of resulting magnification does not vary much among observers who have learned to relax their accommodation. Lauber has devised a method by which the degree of magnification can be actually measured. On three emmetropes the horizontal diameter of the blindspot was determined accurately by perimetric examination and the angular measure transposed into the linear measure, the axial length of the eyes being assumed to be 22 mm. By watching a horizontal slit of light of variable length the observer obtained an after-image the length of which was compared to the ophthalmoscopic width of the disks of the aforementioned emmetropes. By varying the length of the slit producing the after-image, the latter could be made as long as the width of the disk. The distances into which the observers were projecting their ophthalmoscopic images were obviously the distances at which the formation of the after-images had taken place, that is the distances between the observer and the slit. Lauber figures that the magnification of direct ophthalmoscopic images varies between ten and eleven and nine-tenths times.

P. C. KRONFELD.

Neurology

AUTONOMIC INNERVATION OF THE EYELIDS AND THE MARCUS GUNN PHENOMENON. F. H. LEWY, R. A. GROFF and F. C. GRANT, Arch. Neurol. & Psychiat. **37:** 1289 (June) 1937.

The authors had previously reported a case of jaw winking which was relieved by section of the motor root of the fifth nerve. The result

of this operation contradicts the two principle theories advanced as an explanation for this phenomenon, namely: (1) that the condition is dependent on a cortical pattern similar to that seen in cases of the Bell phenomenon and (2) that there is a connection between the medullary nuclei of the third, and those of the fifth, cranial nerve. In the operation described the peripheral nerve outside the brain stem was severed, correcting the condition. Neither of the aforementioned theories explain this. However, in the patient under consideration, passive movement of the jaw after operation still produced elevation of the lid, suggesting to the authors that a proprioceptive element was the afferent arc of the reflex, the motor pathway still being unknown. These points suggested that the autonomic nervous system may be a factor in the condition and that the condition simulates the pseudomotor phenomena of Vulpian, Heidenhain and Sherrington.

To establish this similarity the authors sectioned the third nerve in cats, after which they were able to widen the palpebral fissure by injection of certain drugs, such as acetylcholine and nicotine, which stimulate the sympathetic system. To inhibit this response they used epinephrine and atropine. They felt that this demonstrated that sympathetic innervation in cats is responsible for the reaction. That this response did not occur if the first division of the fifth nerve was already severed proved that the efferent motor arc of the phenomenon is conveyed by this nerve. In a future paper they hope to establish the intramedullary connections of the autonomic nerves which are responsible for the response.

R. IRVINE.

Ocular Muscles

SURGICAL RESULTS IN 223 CASES OF HETEROTROPIA. C. BERENS, Am. J. Ophth. **20:** 266 (March) 1937.

Berens gives the following summary and conclusions:

"1. Of 49 patients (Group I) with varying degrees of esotropia and exotropia, some of whom had alternating strabismus and who received no orthoptic training preoperatively or postoperatively, only 6 percent became heterophoric postoperatively. Heterotropia persisted in 94 percent of the patients.

"2. Of 85 patients (Group II) with varying degrees of esotropia and exotropia, some of whom had alternating strabismus and who were given orthoptic training postoperatively, heterophoria was present in 32 percent (some degree of binocular vision was found in 61 percent).

"3. Of 89 patients (Group III) with varying degrees of esotropia and exotropia, some of whom had alternating strabismus and who received preoperative and postoperative orthoptic training heterophoria was present in 49 percent (73 percent had some degree of binocular vision).

"4. By combining Groups II and III, it is evident that heterophoria following surgery and orthoptic training was present in 70 patients (40 percent); heterophoria for distance or near in 11 patients (7 per-

cent); heterotropia persisted in 84 patients (48 percent); and there was no record of whether heterophoria or heterotropia was present in nine patients (5 percent).

"5. Forty-seven (70 percent) of 67 patients with alternating esotropia or exotropia developed some degree of binocular vision.

"Twenty-nine (75 percent) of 39 patients who developed alternating squint between the ages of one and four years had some degree of binocular vision following treatment. Prior to operation only 12 patients were known to have had some degree of binocular vision.

"Seven of eight patients who had strabismus before the age of one year developed some degree of binocular vision.

"6. That orthoptic training may be important in the development of normal retinal correspondence postoperatively is suggested by the fact that 25 percent of 126 patients with heterotropia had false projection and following orthoptic training the number was reduced to 10 percent.

"7. Correction of aniseikonia seemed to be a factor in aiding fusion in two of six patients with alternating esotropia.

"8. Of 85 patients with amblyopia, improvement in vision apparently occurred in 53 eyes (62 percent)."

W. S. REESE.

SOME CASES OF PARALYTIC SQUINT. P. G. DOYNE, Brit. J. Ophth. **21:** 531 (Oct.) 1937.

Doyne has been impressed with the frequency of some muscular weakness as shown by the synoptophore—an incomitance—in cases of congenital or early infantile paralytic squint. In the cases reported the paralysis had been present at least seven years. In four cases the head was rotated in the interest of parallelism, and in the rotated position there was fairly good, though not fully developed, fusion. False correspondence was present in one case. In two patients too young for a synoptophore reading to be taken the condition appears to be developing along the same lines as in the aforementioned four cases. One patient with bilateral paralysis of abduction has acquired complete false correspondence and in this manner attempts to express her binocular sense. One patient with vertical paralysis made no attempt at binocular function and does not posture.

W. ZENTMAYER.

Orbit, Eyeball and Accessory Sinuses

ETIOLOGY OF THE CHRONIC INFLAMMATIONS OF THE EYEBALL. W. WEGNER, Klin. Monatsbl. f. Augenh. **98:** 15 (Jan.) 1937.

Wegner refers to the research on ocular tuberculosis done at the University Eye Clinic in Freiburg, Germany, by Manz, Axenfeld and Stock. Then he reports data gathered by observation of 600 patients with suspected ocular tuberculosis at the same institution during the last four years. The result was no proof of the theory of the antagonism between pulmonary and ocular tuberculosis. On the contrary, there was a parallelism evident in this respect, as was pointed out pre-

viously by Werdenberg. Wegner frequently found in his patients with suspected ocular tuberculosis tuberculous disease of the bones, skin and glands and also tuberculosis in the family. The diagnosis of ocular tuberculosis is not less contradicted by scarcity of general symptoms than is the diagnosis of tuberculosis of the skin or of the bones. Wegner discusses the favorable effect in some ocular diseases of the parenteral administration of albumin and of endotoxins of bacteria, including those of saprophytic and even pathogenic types. Intercurrent febrile inflammations, such as tonsillar angina, are known to produce similarly favorable results. Their effect, however, is undesirable, or even detrimental, in the various stages of tuberculosis. This fact became evident during two epidemics at the ophthalmic sanatorium in the Black Forest.

In the first epidemic, 43, and during the second epidemic, 27, of 120 patients, contracted a highly infectious type of tonsillar angina. Of these 70 patients, 28 had iridocyclitis, 14 choroiditis and the others keratitis, scleritis, periphlebitis, conglomerate tubercles or inflammatory detachment of the retina; 7 had nonspecific manifestations, in the author's opinion. No change was brought on by the tonsillar angina in 21 of these patients with tuberculous iridocyclitis, while this disease produced a distinct exacerbation, with formation of a hypopyon and diffused opacities in the vitreous, in 7 others. Exacerbations were observed in the patients with keratitis but not in those with periphlebitis or choroiditis. These two epidemics may be termed unintended experiments. They furnished proof for the actual occurrence of ocular tuberculosis, the existence of which has been disputed again recently.

K. L. STOLL.

Pharmacology

THE USE, IN OPHTHALMOLOGY, OF TWO NEW SALTS OF PARA-AMINOBENZOYLDIETHYLAMINO-ETHANOL HYDROCHLORIDE (THE BASE OF PROCAINE HYDROCHLORIDE): THE PHENYLPROPRIONATE AND THE ISOBUTYRATE. A. MONBRUN, J. RÉGNIER and P. JOURDY, Arch. d'opht. **53:** 349 (May) 1936.

The authors describe two new anesthetics, each of which has an anesthetic strength comparable to that of cocaine hydrochloride and a weak toxicity comparable to that of procaine hydrochloride. In the laboratory, the action of the phenylproprionate of para-aminobenzoyldiethylamino-ethanol hydrochloride on the rabbit's cornea was shown to be eighteen times more anesthetic than that of procaine hydrochloride, before sterilization. After sterilization and aging the difference was even greater. This salt produces good anesthesia when administered by instillation for operations such as those for cataract, but it produces disagreeable burning and vasodilation. For this reason it was discarded for use by instillation. When given by injection it has a very satisfactory action, producing better and more rapid anesthesia than that induced by procaine hydrochloride. A 2 per cent solution is used.

The isobutyrate is used in a 5 per cent solution for surface anesthesia. It is nonirritating and in only a few cases has produced slight conjunctival hyperemia. Its action is more rapid that that of cocaine hydrochloride but also passes off more quickly. No desquamation of the

cornea, dilation of the pupil or change in the intra-ocular tension is produced. It is especially valuable when it must be used frequently for a long time. It can be combined with zinc sulfate.

S. B. MARLOW.

Physiologic Optics

IMPORTANCE OF ANISEIKONIA. E. JACKSON, Am. J. Ophth. **20:** 16, (Jan.) 1937.

This interesting article does not lend itself to abstracting. Jackson points out that patients should be warned that time is necessary for them to become accustomed to glasses which cause a change in the size and form of retinal images. Such changes require changes in cerebral associations of the visual process.

W. S. REESE.

DIFFERENCES IN SIZE OF THE OCULAR IMAGES ARISING FROM ASYMMETRICAL CONVERGENCE. W. HERZAU and K. N. OGLE, Arch. f. Ophth. **137:** 327 (Aug.) 1937.

This paper was read, in abridged form, before the New England Ophthalmological Society on May 23, 1936 (*Am. J. Ophth.* **20:**.418 [April] 1937). Three types of differences in size of the ocular images can be distinguished: (1) a physiologic type arising from asymmetrical convergence, (2) artificial differences induced by spectacle lenses of different magnifications and (3) the "pathological" differences, which constitute true anisokonia. With regard to the first type mentioned, evidence is presented in the paper which indicates the existence of some type of mechanism that compensates for differences in size occurring when looking to the right or left at near visual range. Experiments on the horopter apparatus show nearly complete compensation of the differences in size in the vertical meridian and partial compensation in the horizontal meridian. These results offer a logical explanation for the fact that the differences in size introduced by asymmetrical convergence do not interfere with reading. Through the action of the compensation mechanism, fusion of the two images of unequal size is accomplished.

P. C. KRONFELD.

Physiology

RESEARCH ON THE RESPIRATION OF THE OPTIC NERVE. D. MICHAÏL and S. BENETATO, Arch. d'opht. **53:** 346 (May) 1936.

Except for the work of Tashiro, no studies of this nature have been done on the optic nerve, although great advances have been made in studies on other nerves. The material was obtained from two injured eyes, five glaucomatous eyes and four eyes with atrophy of the optic nerve. The average figure for the mean consumption of oxygen for the injured eyes was 114 cu. mm. per gram of optic nerve per hour; that for the glaucomatous eyes, 172 cu. mm., and that for the eyes with atrophy of the optic nerve, 197 cu. mm. The increase, Michaïl and Benetato suggest, is partly explained by the activity of the remaining nerve fibers and by the infiltration of connective tissue.

S. B. MARLOW.

Retina and Optic Nerve

SUDDEN OCCLUSION OF RETINAL ARTERIES. A. J. BEDELL, Am. J. Ophth. **20:** 237 (March) 1937.

Bedell discusses sudden closure of the main retinal artery and reports eight cases, illustrated with photographs of the fundus. He arrives at the following conclusions from analysis of the photographs and fields:

"That there is a definite straight-line field defect, even when the edematous retina presents a crenated border.

"That the macula may be partly encircled and yet central vision be retained.

"That an embolus may be visible at the apex of the region of white retinal edema which coincides with the part of the retina supplied by that particular artery.

"That a field defect suggesting a raphe is present, is readily recognized, and has been frequently recorded.

"The review of the cases here presented shows:

"That the majority of patients have complained of sudden loss of vision without premonitory obscurations.

"That some occlusions are definitely coincident with cardiac disease and others with hypertension.

"That after a vessel has once been occluded it seldom, if ever, reopens, but remains as a visible white line."

He pleads for this combined method of parallel study of photographs and fields.

W. S. REESE.

MECHANISM OF SPONTANEOUS RETINAL DETACHMENT. Y. SUGITA, Arch. f. Ophth. **137:** 447 (Aug.) 1937.

If the enucleated eyes of animals are put in concentrated salt solutions or if such solutions are injected into the vitreous of enucleated eyes, a retinal detachment develops which, according to Sugita, is analogous to the process of plasmolysis in plant cells. The dehydrated retina cannot maintain its normal shape and position. In the case of spontaneous retinal detachment in man, the liquefaction of the vitreous causes, by the breaking up of larger molecules into smaller ones, an increase of the osmotic concentration which prevails on the inner side of the retina and consequently leads to dehydration and separation of the retina.

P. C. KRONFELD.

A CASE OF A HITHERTO UNDESCRIBED RAPID FORM OF PIGMENTARY DEGENERATION OF THE RETINA ASSOCIATED WITH COMPLETE DEMENTIA. W. STOCK, Klin. Monatsbl. f. Augenh. **97:** 577 (Nov.) 1936.

Stock refers to a special form of pigmentary degeneration of the retina that he observed in three children of the same parents. (*Klin. Monatsbl. f. Augenh.* **46:** 225, 1908). The ocular symptoms started in the sixth year of life in these patients, terminating in total blindness and dementia. The histologic observations, which varied in each of the three children, were described in detail. A similar condition recently observed by Stock in a man aged 25 is reported and illustrated with

colored pictures. Vision of the right eye failed completely within six months and that of the left within about one month. The patient had an epileptic attack during observation at the ophthalmic clinic. Other epileptic attacks followed; dementia developed, and the patient died a few weeks later. No anamnestic data of importance were found, excepting that one sister had epilepsy. The nervous elements of the retina were completely degenerated. The degeneration occurred so rapidly that the glia had not yet proliferated, and no pigment epithelium had invaded the retina. For the same reason the glia and connective tissue had no time to fill out the vacuoles. The lacunae in the optic nerve resembled those noted in glaucoma and myopia. Stock thinks that the presence of lacunae without the formation of an excavation of the optic nerve supports his opinion that the lacunae cannot be the cause of an excavation.

The form of pigment degeneration here described differs from the known form as follows:

1. It involves the entire retina simultaneously, whereas the known form begins either in the periphery of the retina, progressing toward the macula, or in the equator, progressing toward the periphery and the macula. The absence of dementia points to an isolated disease of the retina in the known form.

2. The onset in the new form is at a more advanced age and may affect a hitherto healthy person.

3. Degeneration of all the ganglion cells of the brain is characteristic; the patient dies from decay of all the organs of the central nervous system. Final high fever can be explained as a result of involvement of the center of regulation of the bodily temperature.

K. L. Stoll.

A Possible Familial Connection Between a Certain Blood Group and Hereditary Pigmentary Degeneration of the Retina. R. Tertsch, Klin. Monatsbl. f. Augenh. **97:** 585 (Nov.) 1936.

Tertsch attempted to find whether a law exists by which the disposition of a certain hereditary disease may be predicted in a certain person prior to the development of symptoms. After discussing the significance of certain blood groups, and adducing a number of genealogies, the author arrives at the following conclusions from his research:

It is likely that among "direct" brothers and sisters a connection exists between hereditary degeneration of the retina and affiliation to a certain blood group. However, this disease is not connected with a definite blood group, but it may occur in persons of any blood group, as evidenced by data in the genealogies. The afflicted children studied belonged to the same blood group, while the homozygotically healthy children belonged to another blood group than the diseased ones. Furthermore, the phenotypically healthy but heterozygotically diseased children belonged to the same blood group as the homozygotically diseased ones.

The practical value of this research is the solution of the question whether a division is possible between hereditarily healthy persons

and persons with hereditarily suspicious signs for the sake of preventing hereditarily diseased offspring. Examination of other families with hereditary pigmentary degeneration of the retina as to the blood groups to which they belong would further the solution of this problem.

K. L. STOLL.

Trachoma

STUDIES ON THE INFECTIVITY OF TRACHOMA. L. A. JULIANELLE and R. W. HARRISON, Am. J. Ophth. **20**: 353 (April) 1937.

Julianelle and Harrison give the following summary and conclusions:

"1. The infectious agent of trachoma may be liberated of extraneous bacteria by passage through rabbit testicle.

"2. The infectious agent does not multiply during such passage, but retains its viability and infectivity.

"3. No changes are observable in rabbit testicle during passage which are referable to the agent.

"4. It was not possible to continue passage in series through rabbits.

"5. Survivability in testicular tissue is not related to the presence of detectable elementary or initial bodies.

"6. On other occasions, the infectious agent may be freed of bacteria by intracerebral inoculation of rabbits, in which case the brain tissues show no specific reaction.

"7. The cumulative evidence, therefore, suggests that the infectious agent of trachoma may be a virus."

W. S. REESE.

NEW RESEARCHES ON TRACHOMA. A. CUÉNOD and R. NATAF, Arch. d'opht. **53**: 355 (May) 1936.

In this report Cuénod and Nataf try to show the nature of the observations in smears and sections which have already been reported on. The question of the rickettsias is discussed, and reference is made to the work of Hertig and Wolbach, Weigl, Rocha-Lima, Anigstein, Busacca, and Thygeson. The experiments detailed first consisted of taking uninfected lice and showing that they can be infected with trachoma material, the virus being found in the intestinal tract, resembling closely what has already been demonstrated in smears and cultures. The second step was the infection of healthy monkeys with ground-up infected lice by subconjunctival injection and by surface inoculation with scarification. The result was the occurrence of typical trachomatous follicles in these animals, with the demonstration in smears of the same organisms as reported for smears from human beings. Further research is in progress. The work so far seems to establish the parasitic nature of the disease and the probability of its origin and of at least one of its modes of transmission through insects harboring rickettsias.

S. B. MARLOW.

Tumors

SYMMETRICAL ORBITAL TUMORS: REPORT OF A CASE. R. VOELKEL, Klin. Monatsbl. f. Augenh. **98:** 169 (Feb.) 1937.

Voelkel reports two cases of symmetrical bilateral tumor of the orbit. The tumors represented systemic diseases of varying clinical appearance. Forty cases of this condition have been reported, but it seems to occur more frequently than this number of reports would indicate. The short time allotted to observation, failure to make excision for histologic examination and lack of a case history may be responsible for the fact that these tumors were considered pseudotumors of unknown origin. Such tumors consist of reticular tissue and of infiltration of lymphoid cells. Resembling genuine tumors, these lymphomas or lymphomatoses are chronic inflammatory hyperplastic lesions which develop on the basis of a general disease of the lymphatic system, such as leukemia, aleukemic lymphadenosis or lymphogranulomatosis.

The first case concerns a man aged 24 with symmetrical exophthalmos and reactive osseous degenerations, osteoporosis and osteosclerosis of the orbit, extending into the ethmoid bone.

An excised piece of tumor contained islands of cells in a tough tissue. The islands consisted of granulation tissue with large histiocyte elements and lymphocytes, eosinophil leukocytes and giant cells resembling Sternberg's giant cells. Numerous foci of hyalinization and sclerosis were observed. Krönlein's operation was performed on the right eye when the exophthalmos increased, revealing a large, tough tumor which covered the posterior portion of the eyeball like a shell. The rearmost portion of the tumor could not be removed from the apex of the orbit. This patient presented symptoms resembling those of Mikulicz' disease.

The second case is that of an emaciated woman aged 42 with proleukemic or leukemic lymphadenosis; most of the lymph glands and also the thyroid gland were enlarged. The lids were protruding and tense; the fornices were swollen, soft and grayish red. This glassy mass separated the eyeball and the lids, which, when everted, remained in that position. An excised portion of the lid showed no amyloid, as was expected, but massive infiltration by round cells with a large dark nucleus, after staining with hematoxylin, and scarcity of protoplasm—leukemic infiltration. Tracheotomy, which was performed because of increasing dyspnea, showed hard infiltrations in the subglottic space; they consisted of lymphoblastic elements containing no Mikulicz cells and only a few eosinophil cells. The patient died two months later from general weakness. The diagnosis was the proleukemic stage of lymphadenosis.

The orbital tumors were the first symptom observed in these two cases, and the diagnosis could be established after examination of an excised piece.

K. L. STOLL.

Uvea

A CASE OF UVEOPAROTITIS. TOULANT and MORARD, Arch. d'opht. **53:** 321 (May) 1936.

Toulant and Morard have collected a total of ninety-seven instances of uveoparotitis from the literature, in five of which the condition

was uncertain. This number includes some cases described as instances of Mikulicz' syndrome, the description of which make them appear to be cases of uveoparotitis. Women were found to be affected in 55 per cent. In two thirds of the patients the disorder occurred between the ages of 10 and 30 years. The disease is not contagious. The majority of the cases have occurred in Anglo-Saxon countries. Clinically the disease is characterized by (1) hypertrophy of the parotids; (2) an ocular manifestation, consisting usually of uveitis; (3) slight fever; (4) facial paralysis and various other pareses, and (5) accessory symptoms, such as multiple glandular invasion, general adenopathy, and visceral and cutaneous lesions. These are all discussed, and the reports in which they have been described are cited. The development of the disease is essentially subacute or chronic, four stages being recognized —a prodromal stage, the onset of which may be hypertrophy of the parotids; iridocyclitis; facial paralysis, and cutaneous lesions and swelling of the lacrimal gland. The fully developed stage is characterized by the coexistence of uveitis and swelling of the parotids. Its duration is never less than fifteen days and is often longer than two months. The period of regression is prolonged. Loss of vision is often the result. The pathologic changes of the disease consist essentially of epithelioid infiltration with the formation of nodular masses. All work to determine the pathogenesis has so far been without results. Theoretical considerations have incriminated mumps, syphilis and tuberculosis, but the evidence is inconclusive. Toulant and Morard are inclined to accept the suggestion of Merrill and Oaks that the disease is due to a special virus as yet unidentified. Treatment is symptomatic. No one form has proved beneficial in all cases. The authors report a new case, which was studied in detail. A complete bibliography is listed.

S. B. MARLOW.

Vitreous

DETACHMENT OF THE VITREOUS: REPORT OF CASES. R. BASSIN, Klin. Monatsbl. f. Augenh. **97:** 599 (Nov.) 1936.

There are two types of detachment of the vitreous: the anterior type, in the area of the ora serrata, and the posterior type, near the disk. Only the latter form was known up to 1924. Bassin published a report of two cases of posterior detachment of the vitreous in 1932, and he adds a third case in this report. A man aged 38 with myopia of 23 D. presented a gray, oval opacity in front of the disk. Its margin was 1 mm. wide and open below. Moving only slightly on motion of the eye, it regained its original position at once. While the upper portion could be observed distinctly with a 12 D. concave lens, the lower portion could not be outlined. This seemed to indicate either that the detachment was incomplete or that its lower portion had remained clear. Temporally and below the disk was a diffused, rolled-up gray mass measuring about three-fourths the size of the disk. The choroid around the disk was atrophic; the course of the retinal vessels was not interrupted.

The author reports also a case of anterior detachment of the vitreous in a man aged 70. The detachment was observed after intracapsular extraction of a cataract with iridectomy. The anterior chamber was

deep, and an oblique oval opening was noted behind the iris in the direction from 1 to 7 o'clock, its outline being clearly visible through the coloboma.

The slit lamp revealed a whitish gray membrane with a slightly thickened margin and folds running parallel to it. The membrane lay in the frontal plane, oscillating slightly on extreme motions of the eye.

Bassin thinks that the detachment of the vitreous was caused by pressure on the eye and massage during the difficult delivery of the lens. The detachment was facilitated by the loose connection of the vitreous with the ciliary body and the zonule of Zinn, which, on the other hand, prevented detachment of the retina.

K. L. STOLL.

Therapeutics

THE ROLE OF PARACENTESIS IN OPHTHALMOLOGY. W. F. HARDY, Am. J. Ophth. **19:** 1097 (Dec.) 1936.

Hardy remarks on the paucity of the literature on paracentesis and the important part this procedure plays in many serious ophthalmic conditions. He discusses the rôle of the aqueous and the question of recovery of an eye when a corneal ulcer perforates, and enumerates the various conditions for which paracentesis is used. The case of a 43 year old man who, after a blow on the eye, suffered from repeated blebs of the cornea, is reported. Numerous forms of treatment were tried; improvement followed paracentesis, and after this procedure was repeated five times the eye made a full recovery.

W. S. REESE.

Toxic Amblyopia

TREATMENT OF TOBACCO AMBLYOPIA BY ACETYL-CHOLINE. B. H. CRAGG, Bristol Med.-Chir. J. **53:** 237, 1936.

Since July 1936 Cragg has treated five male patients suffering from tobacco amblyopia by the intramuscular injection of acetylcholine bromide. The drug is available in two doses, dose A being 0.03 Gm. and dose B 0.125 Gm. Each patient first received two injections of dose A with an interval of one day between and then a daily injection of dose B until no further treatment was considered necessary or until improvement ceased. In addition, patients 4 and 5 were given 1/150 grain (0.0004 Gm.) of physostigmine sulfate daily by mouth, on the basis of the suggestion that the action of acetylcholine is enhanced by minute doses of this drug. The results were encouraging: It was found that treatment by this method gives more rapid improvement in vision than that by other methods. The patient in most cases realizes that overindulgence in tobacco has been the cause of his defective vision.

J. A. M. A. (W. ZENTMAYER).

Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

GERMAN OPHTHALMOLOGICAL SOCIETY

Fifty-First Annual Meeting, July 6-8, 1936

DOCENT DR. M. BÜCKLERS, Tübingen, *Reporter*

TRANSLATED BY PERCY FRIDENBERG, M.D., New York

Demonstration Session

Tuesday, July 7, 1936

WOLFGANG RIEHM, M.D., Giessen, *Chairman*

IMPROVEMENTS IN PERIMETRY (MAGGIORE'S PROJECTION PERIMETER). DR. PHIL. H. HARTINGER, Jena.

This perimeter, made by Zeiss in Jena, throws images of varying color, size and luminosity on a perimeter arc which is about 8 cm. wide and has a radius of curvature of 333 mm. The inner surface of the arc, which is presented to the eye of the subject, is enameled a dull gray with a white content of about 35 per cent. The test field extends from a central cruciform test object 100 degrees to right and left. The test objects are 10, 5, 3 and 1 mm. in size, corresponding to visual angles of 1.7, 0.9, 0.5 and 0.2 degrees, respectively. The colors, red, yellow, green and blue, correspond almost to those of the so-called Heidelberg perimeter. The luminosity can be reduced quickly and accurately by three smoked glasses with a permeability to light of ¼, 1/16 and 1/64. By means of a hand wheel, the test object can be moved noiselessly from one extremity of the arc to the other and stopped at any desired point. There is also a "blinking" arrangement by means of which the test image can be instantaneously extinguished or made to reappear. The diagram for the notation of the visual field is fastened in a frame and remains stationary while the arc and the light projector are rotated. The wires for the latter, running over the diagram, accordingly indicate unmistakably the axis of the meridian which is under examination at any given moment. A pencil carried along in the course of the wires allows the accurate designation of the location of the test image. The field diagram corresponds to the accurate "equidistant polar projection" of Förster, adopted at the International Ophthalmological Congress at Madrid in 1933. The scale division of the semicircular arc corresponds to the Oca diagram, and the notation is supposed to take place as if the observer were looking at the drawing of the outline of the visual field from the convex side of the perimeter arc. This field diagram is illuminated uniformly and equally by the only light source of the apparatus, without the subject under examination being in any way aware of this illumination. Great care has been taken in the

construction of this apparatus to ensure the correct and unchanging position of the subject's eye. The chin rest and brow support can be raised and/or lowered and also rotated about a vertical axis and shifted to one or the other side, so that either eye can be brought rapidly to center on the perimeter arc. The inclination of the head rest can be regulated and, with it, the distance of the tested eye from the perimeter arc. In addition, three different chin rests are provided. To exclude the eye which is not under observation, two tongue-shaped "blinders" are attached to the head rest and can be rotated and lowered with it. Finally, an important innovation is presented—a provision for the optical centering of the eye under examination. Image projectors are placed in two tubes which run obliquely downward from the lamp holder. From two spatially separated points two luminous rings are projected on the subject's eye. When these rings coincide and are concentric to the pupil, the eye is exactly at the center of the perimeter arc. The observer is able to center the subject's eye, to map the visual field and to watch the field diagram and the patient from one and the same place. The luminosity of the test object images remains unaltered during the determination of the limits of the visual field, and the color and luminosity can be repeated accurately when and as desired. Accordingly, the data of measurements at different times or places can be compared without question. The color, luminosity and size of the test object image can be varied quickly without attracting the attention of the patient. Finally, this change in position of the optically produced test objects takes place silently, so that the subject gets no hint which might influence or falsify his statements in an undesirable way.

PRESENT FORM OF APPARATUS FOR MEASURING THE POSITION OF THE VISUAL AXIS IN NEAR VISION. DR. LUDWIG PAUL, Lüneburg.

This instrument is a mechanical improvement on the model described in the *Klinische Monatsblätter für Augenheilkunde* (**93**: 528, 1934). The reading test cards, formerly movable, are now fastened. The data gained correspond perfectly with those obtained with the old apparatus, but examination is greatly facilitated in that the subject has now only to indicate on the reading disk the place where the red marker seems to lie. It is seen only by the fixing eye, having been projected into the visual field of this eye by the exclusion of binocular vision. All measurements of inclination (*Rollung*), fusion movements, etc., can be carried out just as with the older model. The subject easily understands the simple order to point out the red marker which he perceives, so that the examination, which may be of essential significance in the diagnosis and treatment in a given case, can generally be carried out in a few seconds. The apparatus is made by Wurach in Berlin.

A NEW MEASURE OF INTERPUPILLARY DISTANCE. DR. H. HARMS, Berlin.

The instrument which can be used to measure the distance between the centers of rotation (by the subjective method) also measures the interpupillary distance objectively. It consists of two parallel tubes

which can be reciprocally displaced. Each tube contains an iris diaphragm (*Schluessellochblende*) with a needle placed behind the central opening. The central opening and the needle must coincide when the center of rotation of the eye is in the axis of the tube. If both tubes are correctly centered, according to directions, their distance apart will correspond to that of the centers of rotation of the two eyes. The possibility of an obliquity of the so-called basal line can also be taken into consideration. The examining physician can sight the upper part of the subject's nose and read the distance from the right point of rotation. If the entire instrument is turned around and the diaphragm pushed out of the tubes, the points of the needles can be brought opposite the middle of the subject's pupils and their distance from one another measured.

A Method for Continuous Registration of Dark Adaptation. Prof. Werner Kyrieleis, Hamburg.

A mechanism is described by means of which the width of the diaphragm (*Blendenweite*) of the Engelking-Hartung adaptometer is continuously registered on the drum of a slowly running kymograph. In this way up to ten determinations of threshold values per minute can be carried out. In addition, the finer details of the course of the curve for dark adaptation are presented much better than with the older methods previously in use. The mechanism seems invaluable and essential for the study of after-images resulting from dazzling and similar reactions.

Simple Attachment to the Comberg Ophthalmoscope (Model I) for Focal Examination of the Fundus. Prof. Alois Meesmann, Kiel.

This attachment consists of an iris diaphragm the aperture of which can be regulated by a ring at the periphery. This is mounted in a cylindric case which can be shifted up or down, so that with refraction errors up to myopia of 12 D. it is possible to focus sharply on the background of the eye. The upper half of the original illuminating tube is unscrewed and replaced by one which contains the attachment just described. The instrument can be used for examination in the upright or in the reversed position, and its use at the operating table or at the bedside is very simple.

Deposits of Cholesterol Crystals on the Posterior Surface of the Cornea and the Anterior Surface of the Lens in an Otherwise Sound Eye. Prof. Alois Meesmann, Kiel.

Examination of a patient aged 66 with pernicious anemia of a mild degree showed no arcus lipoides and no rise in the cholesterol content of the blood. The possibility of a relation of toxic steatosis to pernicious anemia is considered, as is that of a variation in the chemical composition of the aqueous humor, with resulting sedimentation of crystals. Further investigation might determine whether such changes are fre-

quent in cases of pernicious anemia. As they do not interfere with vision, it is possible that they are often present but are overlooked and so have remained unknown.

THE ANGULATED MICROSCOPE FOR EXAMINATION OF THE VITREOUS AND FUNDUS IN THE SLIT LAMP BEAM. PROF. KARL LINDNER, Vienna.

The microscope is mounted on the stand of the ordinary slit lamp. Sighting takes place directly across and through the instrument. In addition, the slit must be narrowed to the smallest possible dimensions. A contact glass with a small surface is used. The one I use has a diameter of 15 mm. A contact glass is being prepared with a flat surface curvature which will permit of the examination of the fundus oculi as well. With this helpful accessory, one can examine the vitreous and the fundus in serial sections, so to speak, with the slit lamp beam. Particularly excellent pictures are obtained by examination with red-free light, which, however, requires a special arc lamp (direct current) for a light source.

THE COLLOIDOMETER, A SLIT LAMP ATTACHMENT FOR THE DETERMINATION OF CHANGES IN LUMINOSITY IN PATH OF LIGHT IN THE ANTERIOR CHAMBER. PROF. HENNING RÖNNE, Copenhagen, Denmark.

In passing through the cornea, the beam of the slit lamp produces a path of light the luminosity of which is essentially greater in the cornea than in the aqueous with its more or less considerable albumin content. The colloidometer makes use of a Recoss disk with twelve graduated gray (smoked) glasses to dim the slit lamp beam partially until there is equality between the path of light through the undimmed anterior chamber and that through the dimmed cornea. In this way one can determine the varying path of light in the anterior chamber as compared with the constant path in the cornea. As each of the twelve gray glasses has a different and definite potential of light transmission, the dimming value of the neutralizing or equalizing glass will give the albumin content of the aqueous. At the same time this allows one to follow the course of iritis from the beginning to the end, quantitatively and graphically (*kurvenmässig*). Variations in the luminosity of the path of light in the anterior chamber are more than a thousandfold. The instrument is made by Carl Zeiss in Jena.

DEMONSTRATION OF A CYCLOPHOROMETER. DR. H. HARMS, Berlin.

This cyclophorometer is a stereoscopic apparatus with two rotating arms. The separation of their centers of rotation is made equal to that of the ocular centers of rotation. Each arm carries an object disk with a centrally placed circle of apparently equal dimensions. One of the disks is small and square (*quadratisch*) and is made of paper ruled in millimeter squares. It is placed in front of the eye at a distance of 6.7 mm. The other disk is large and round, can be rotated and bears a red streak which runs through the middle point. This disk is

33.3 cm. distant from the eye. By the placing of a + 15 D. sph. and a + 3 D. sph., respectively, in front of the eyes, the disks are transported into the far point of vision of an emmetropic eye. The red line now appears to one looking into the apparatus to lie in the plane of the chart paper and is made to fix parallel to the vertical rulings. Its inclination to the vertical corresponds to the reciprocal inclination of corresponding retinal meridians. Allowance must be made, of course, for errors of refraction in putting on the plus lenses. Any desired accommodation can be elicited by using weaker lenses, and any desired convergence can be enforced by rotating the arms of the stereoscope inward. This apparatus has various practical applications.

AN APPARATUS FOR TRAINING CENTRAL VISION IN FUNCTIONAL AMBLYOPIA. PROF. W. COMBERG, Rostock.

This apparatus is intended to exercise the macular region of an eye with eccentric fixation. With the aid of this fixation, the eye is placed in such a position, the head being supported on a chin rest, that the macular region is directly opposite a test object. When a button is pressed, the red light of the eccentric fixation point disappears and a very bright image is flashed for a moment onto the macular region. The training exercises are held in a dark room so as to keep the eye free from all extraneous stimuli. The test objects are arranged on a rotating disk which the subject turns, constantly bringing new test objects into position for this procedure in a succession of which he has no inkling. There are changeable rings with test objects of different sizes corresponding to vision of 1/30, 1/10 and so on.

SIMPLIFIED COMBERG X-RAY APPARATUS FOR THE LOCALIZATION OF FOREIGN BODIES. DOCENT DR. MAX BÜCKLERS, Tübingen.

In order to minimize errors in taking roentgenograms, I have had an instrument constructed in which all requirements of accuracy are ensured by simple manipulations. For this purpose, the Siemens roentgen sphere is mounted 60 cm. above the exposure table in such a way that it can be moved in only two directions above the plate, which is held fast in a frame. A millimeter scale attached to the directing rod and to the detachable sighting mirror is used to correct centering, so that the central light ray shall be invariably vertical to the middle of the plate and to the middle of the mirror, respectively. For fixation there is an accessory light source which fits into the bayonet lock of the x-ray tube holder in such a way that the miniature lamp lies exactly in the direction of the central light ray.

INJURIES TO THE EYE FROM COMPRESSED AIR WITHOUT EXTERNALLY VISIBLE LESIONS: DEMONSTRATION. DR. LABIL REINHARD BRAUN, Rostock.

The eyes of two patients were subjected to blunt injury by being struck by hose or hose terminals under high pneumatic pressure. In the first case there was a central scotoma, the presence of which was verified by differential pupillometric tests, without any visible changes in the optic disk. In the second case there was papilledema without any dis-

turbance of function. The striking feature in both cases was the complete absence of even the slightest external lesion. It is inferred that the sudden and sharply jolting traumatism had resulted in only slight injury to the optic nerve alone, such as hemorrhage into the nerve sheaths or commotio nervi optici.

UNUSUAL SEQUELAE OF INJURY BY CONCENTRATED TEAR GAS. DR. ROLF SCHMIDT, Freiburg.

Toward the end of November 1935, a patient aged 40 was brought to the hospital two hours after a cartridge containing concentrated tear gas (bromomethylethyl ketone) was shot into his right eye at short range. On admission there was marked swelling of the right side of the face with striate cauterizing of the skin. The lids of the right eye were tensely swollen and bloodshot, and the globe was torn to shreds. The globe was enucleated immediately, evipan (the sodium salt of C-C-cyclohexenyl-N-methyl-barbituric acid) being used for anesthetization. The tissues gave off a highly irritating gas which caused such intense lacrimation that it was almost impossible to complete the operation. In the following days there occurred, quite unexpectedly, a further increase in the swelling of the lids, with marked protrusion of the conjunctival sac. At the same time there developed, together with marked sanious secretion, a progressive necrosis of the remaining orbital tissues and of the lids, which began to slough in shreds. For this reason, twenty days after injury exenteration of the orbit was performed, in the course of which several small splinters of glass were found near the apex of the orbit. Here, again, the gas issuing from the tissues was highly annoying. Even after this procedure the disease process did not come to a standstill. The periosteum of the orbit commenced to slough at different points. The necrosis even extended to the skin of the face and the facial skeleton. The zygomatic process of the frontal bone began to break down, not from within, i. e., the orbital aspect, but from the outside. And now, for the first time, extremely slowly progressive granulation of the extensive wound surface began to take place from the nasal wall of the orbit. By the end of May, half a year after the original injury, the necrosis finally ceased. The remarkable feature in this case is that tear gas, which is generally considered to be harmless and to cause only transient irritation, may cause high grade destruction and permanent damage when it is carried deep into the tissues in a concentrated form. In the case recently reported by Heinsius from the Berlin clinic, severe areas of burn were also present, but the necrosis was limited to the surface and there was none of the progressive severe and spreading destruction of deeper tissues which was observed in the case reported here. Careless handling of tear gas, which is now used rather frequently, may at any time cause a repetition of such injuries.

THE APPEARANCE OF SO-CALLED PIT FORMATION (GRUBENBILDUNG) IN THE PAPILLA NERVI OPTICI OBSERVED WITH THE ANGULATED MICROSCOPE OF LINDNER. H. RIEGER, Vienna.

From colored pictures depicting the so-called pit formation in the papilla nervi optici as seen with the Lindner microscope, it was found beyond dispute that there was a fine cuticulum which spread over the

pit. While two cases do not prove that pit formation invariably represents a cystic cavity in the substance of the nerve head, at least they speak in favor of the histologic interpretation advanced by von Szily in 1913 and again in 1920 to the effect that this malformation is due to defects or actual lacunae in the so-called intercalary portion (*Schaltstueck*).

CONGENITAL ANIRIDIA. DR. W. REICHLING, Berlin.

The eyes of a boy aged 12 weeks were examined histologically. Before death the ocular findings were moderate nystagmus and complete amaurosis. Nothing was to be seen of the iris in either eye, the fundus was strikingly devoid of pigment and the disk showed no gross changes. On account of the restlessness of the child it was not possible to make a satisfactory inspection of the macular region. Of the relatives who were examined, the father, mother and a sister aged 1½ years, only the first named showed any ocular developmental anomaly, viz., an oval pit formation in the nerve head. Histologic examination of both eyes of the patient showed a bilateral anterior polar cataract with considerable iris rudiment. The stroma iridis in each eye was rich in nuclei; the length and breadth of the irides vary markedly, especially in sections which were widely separated. There was ectropium of the uvea on each side. Contrary to what is frequently reported in the literature, both the dilator and the sphincter muscle could be demonstrated in numerous sections. In the filtration angle of the anterior chamber the uveal framework (*Gerüstwerk*) was replaced by a knot of stroma iridis. Where the uveal framework was still present and strands could be followed up, they could be seen in various sections to run on the posterior surface of the cornea and to end in a sort of bolster made up of coarsely fibrous tissue. The most striking histologic change in the retina was the absence of the central area and of rods and cones in many places. A remnant of the hyaloid artery was noted, resting directly on the disk.

CONTRIBUTION TO OCULAR PATHOLOGIC PROCESSES IN IDENTICAL TWINS: PRESENTATION OF TWO DRAWINGS OF THE FUNDUS AND A PHOTOGRAPH OF THE TWINS. DOCENT DR. KURD VOGELSANG, Berlin.

The twins, Gerhard and Arno, were aged 8 years. The right eye of Gerhard showed a sharply defined coloboma of the macula with a profusion of pigment. The right eye of Arno showed a pigmented macular coloboma with a sharp margin and grayish white prolongations to the temporal side. The report from the department for hereditary pathology of the I. Medizinische Klinik der Charité (Prof. Dr. Curtius) stated that undoubtedly identical and hereditarily equivalent (*erbgleich*) twins presented characteristics which were in part asymmetrically mirrored (*spiegelbildlich asymmetrisch*). The father, aged 38, presented a slight irregularity of the pupils, which were not perfectly round. There was a marked physiologic excavation of the disk in each eye, which was more marked in the right. The macula was intact. The mother, aged 38, had had trouble with the right eye for nine-

teen years. The fundus showed tortuosity of the retinal vessels and a deep excavation extending to the margin of the disk. The tension in the right eye was 67 mm. of mercury, and there was perception of light. Examination of the left eye showed a flat papilla, venous pulsation and tension of 38 mm. The diagnosis was juvenile glaucoma (?). The Wassermann reaction was negative in all four subjects. There was almost complete correspondence of the configuration of the colobomas. In considering the significance of this clinical finding from the standpoint of genetics and certification, heredopathologically there were certain relations to the problem of symmetry and to that of coloboma formation in correlation with other developmental anomalies.

PRIMARY GLIOMA OF THE ORBIT. PROF. W. ROHRSCHNEIDER, Cologne.

A 3½ year old boy presented a rapidly growing orbital tumor which was pushing the globe downward and forward. The eyeball presented no pathologic change, and there was no papilledema. Exenteration of the orbit was done. Relapse occurred with metastasis in the lymph glands at the angle of the jaw. The growth was remarkably soft, almost disintegrating, and semifluid (*zerfliessend*). Histologically, the growth was rich in cells of various size; they were mostly round, but some were spindle shaped, and here and there a thick conglomeration of neuroglia fibers could be seen, as proved by Holzer's glia stain. A diagnosis of glioma sarcomatodes was made. The optic nerve was not pathologically altered. The tumor formation was ascribed to embryonic germinal displacement. I wish to call attention to the rarity of primary glioma of the orbit and to the possibility of mistaking the tumor in question for a myxosarcoma.

A PECULIAR FORM OF RETINAL PIGMENTATION: DAPPLED (GESCHECKTER) FUNDUS. PROF. KARL VOM HOFE, Greifswald.

A student of medicine aged 24 presented a peculiar form of retinal pigmentation. The anterior segment of the retina was normal; the media were clear. On the fundus there was a wide area of peripapillary bleaching or of partial depigmentation (*Aufhellung*) around the disk. The greater portion of the fundus, with the exception of the macular region and that around the disk, showed a massive accumulation of pigment, mostly in clumps (*Schollen*), over which the retinal vessels coursed unobstructed. There was only a little scattered pigment, mostly punctate, here and there in the anterior layers of the retina. Between the pigmented areas there were unpigmented areas which reminded one of coloboma and in which no choroidal vessels or only an occasional solitary branch was seen. Vision in each eye was — 5/4. Accommodation was normal and the visual fields for white and blue were also normal. A test for color vision showed deuteranomaly. The course of the curve and the final values for dark adaptation were normal, with a definite sharp notch (*Knick*) in the curve after five minutes. According to the family history an aunt had become blind in her forties from some cause, and the daughter of a cousin who had married a (female) cousin was said to be an albino. A sister of the patient presented a normal fundus. The other anamnestic data could not be verified objectively. In view of

the function, which was normal in every respect, the complete absence of objective symptoms and the family history, it is fair to conclude that the condition being dealt with was a congenital anomaly with a hereditary basis, which is best designated as dappling of the fundus (*Scheckung*). There is no question of the condition's being "grouped pigmentation" (Niels Höeg and others), as the pigment was irregularly scattered, not grouped. But it is probably related in some way to this pigment anomaly as well as to others, such as those described by Jacobi, Kraupa and others.

A Rare Form of Associated Movement of the Eye: Presentation of a Film. Prof. Hugo Gasteiger, Frankfurt on the Main.

A man of 41 was injured by a grenade, the region in front of the right ear being involved. Later, a number of splinters from the projectile were removed by operation. In addition to some neurologic symptoms, the following conditions of the right eye were noted: The fissure in the lid was narrowed, and there was a slight degree of enophthalmos. Abduction was completely absent, but all the other ocular movements were full and free. Chewing movements, depending on their vigor, were associated with weak to violent nystagmus-like movements of the right eyeball in a horizontal direction. These movements were accompanied by a pulsating movement in the region of the radiating cicatrix in front of the right ear. When the chewing motion was finished, the twitching of the eyeball and the pulsation in the region of the scar ceased abruptly. The globe was normal except for a corneal opacity and a delicate cataracta punctata coerulea. The left eye was normal. The cause of the associated movements of the right eye was found to be the cicatricial adhesions between the abducting muscle and the muscles of mastication in the region opened up by the shot. This was proved by the simultaneous movement of the scar and by the roentgenogram which showed the osseous defect and foreign bodies in the right orbit.

Contribution to the Biology of Sarcoma of the Choroid: Presentation of a Series of Colored Photographs of Microscopic Sections. Prof. E. Seidel, Jena.

A woman aged 29 had a condition which was diagnosed elsewhere as a cyst of the ciliary body on the ground of positive scleral transillumination, and an attempt was made to extirpate the supposed cyst. Six months later the globe was enucleated. Histologic examination showed a flat, almost unpigmented sarcoma of the ciliary body, 2 mm. thick and reaching to the equator. In the region of the operative scar and along the canals made around the suture material (female hair) by the needle punctures, tumor cells had proliferated into the sclera. I wish to call attention to the danger of puncturing or of otherwise operatively opening a globe in a case of sarcoma of the uveal tract.

Ocular Metastasis of a Chorionepithelioma Dr. W. Reichling, Berlin.

The eye of a man aged 36 had been enucleated because a choroidal sarcoma was thought to be present. The further clinical course and a

general physical examination demonstrated that the growth was an ocular metastasis from a tumor of the right testicle. Death from multiple metastases took place two months later. Histologic examination of the enucleated eye showed almost complete correspondence of the two neoplastic formations. At many points the cell forms characteristic of malignant chorionepithelioma were found, viz., the syncytial cells, large epithelial cells derived from the outermost fetal layer of the placenta, and the smaller Langerhans cells, derived from the epithelium of the chorionic villi. There were a marked tendency to hemorrhagic effusion at many points and also a severe reactive hyperemia in all the blood vessels of the intra-ocular structures.

(To Be Continued)

Book Reviews

Report of the Ukrainian Institute for Experimental Ophthalmology, 1936, Odessa. By Prof. W. P. Filatoff. Pp. 50. U. S. S. R. Commission of Public Health, 1937.

The Ukrainian Institute for Experimental Ophthalmology is to continue the work begun by Professor Filatoff in the Institute of Medicine in Odessa. The new institute is to contain a clinic service of 100 beds, 6 laboratories and an experimental studio. The institute has been open since Sept. 1, 1936, and this report tells of the work during four months.

One hundred and fifteen patients have been treated in the institute and the following 112 operations have been done: 62 transplantations of the cornea, 27 operations for glaucoma and 23 other operations.

The problems which have been studied during this period have concerned the transplantation of the cornea. Professor Filatoff has been transplanting corneas for many years and has always used eyes obtained from living patients, but the large demand and the insufficient supply of material for transplantation have led him to take eyes from cadavers. Since 1931 he has used these eyes, conserved by cold. The subsequent operations have shown that grafts from this material give just as good, if not better, results than grafts from eyes of living patients. The eyes are preserved at a temperature of from 2 to 4 F. Sixty-two transplantations were made in four months. In only 2 of these was material taken from eyes of living patients.

On January 1 the sum total of the transplants which had been made at Odessa was 380. At present the number has reached 400, and in the case of 200 of these the material was from cadavers. The results were as follows: A transparent graft was obtained in 32 of 44 cases (72.7 per cent); in 8 the graft was semitransparent, and in 4 it was opaque.

The word transparent means the ability to recognize details in the anterior chamber and to obtain a clear reflex from the eyeground.

The period of observation has been increased by four months, and in only 2 cases has a transparent graft become semitransparent.

Photographs illustrating 30 cases of transparent graft and 6 cases of semitransparent graft are given. There are also 9 photographs of eyes which were operated on in the ophthalmologic clinic during 1936, and a detailed description of these cases is given.

The work in the laboratory has consisted in a study of better methods of conserving the cadaveric cornea, the biologic study of the preserved cadaveric cornea and the investigation of the best operative procedure for transplantation. This has shown that the cornea preserved in cold and the dried cornea will remain viable.

The second principal problem has been the elaboration of operations for secondary glaucoma. A series of new trephines for the transplantation of the cornea have been invented by Professor Filatoff and Marzinkowsky.

Nineteen physicians have been studying at the institute, devoting their time to transplantation of corneal grafts and the transplantation operation.

In 1937 the new laboratory and 50 beds will have been available. This will permit the investigators to do more experimental work and obtain better success, with the object of assuring the health of the workers of the country, which is governed by socialism under the direction of Comrade Stalin.

In 1937 the following problems were to be studied:

1. Simplification of the operation of corneal grafting so that it can be performed by all physicians.
2. Treatment of keratitis by transplantation.
3. Treatment of lupus and other cutaneous diseases by transplantation.
4. Further study of transplantation of the cornea from the cadaver.
5. The study of corneal graft as a curative factor.
6. The study of biologic processes in the preserved cornea.
7. The cause of glaucoma.
8. The treatment of secondary glaucoma.
9. The cause and treatment of trachoma.
10. The treatment of pigmentary retinitis and tabetic atrophy of the optic nerve.
11. The treatment of complications of malignant myopia.
12. The production of instruments for corneal grafting.

ARNOLD KNAPP.

La migraine ophthalmique. By G. Renard and A. Pascal Mekdjian. Price, 22 francs. Pp. 146. Paris, Masson & Cie, 1937.

After an introduction and description of the clinical symptoms of ophthalmic migraine, the authors, Renard, professor of medicine, and Mekdjian, assistant in ophthalmology, define the problems which are presented by the visual and the sensory expression of migraine and their localization.

In the second part of the book the special field in which these symptoms occur is examined, and their modification with the patient's age and their morbid associations are discussed. The varieties of scotoma are well illustrated. According to the authors, those suffering from migraine show: (1) digestive disturbances; (2) neurovegetative disturbances; (3) humoral disturbances; (4) oscillations of the arterial tension, with a preponderance of hypotension; (5) psychic disturbances, and (6) endocrine disorders.

One may conclude that the migrainous constitution depends on these secondary states of the neurohumoral-endocrine equilibrium, which are generally unstable and may be acquired or be transmitted by heredity.

There are two groups of disorders which seem to have points of contact with ophthalmic migraine: One develops in the form of crises, the clinical aspects of which resemble those of a migrainous crisis; in this group belongs particularly the usual type of migraine and of epilepsy. The second group includes varying disorders which seem to be produced

in persons of the same constitution as those with ophthalmic migraine, alternating with or accompanying this condition, as gout, obesity, diabetes and other conditions.

There is no uniform treatment for migraine. When a patient with ophthalmic migraine comes for treatment it is necessary to examine the eyes, digestive function, endocrine organs and arterial tension. In addition to treating these symptoms, it is necessary to change the patient's make-up. For this hygiene is necessary—the avoidance of fatigue, excesses and a sedentary life, and other measures. It is well to remember that strong remedies should not be used. The authors employ for patients with frequent crises phenobarbital in repeated doses of from 1 to 2 grains (0.06 to 0.1 Gm.) in the evening. Then, for periods of from eight to sixteen days, before the midday meal, from 5 to 10 drops of tincture of belladonna is given. Most patients improve with this treatment. In addition, in cases in which crises are not frequent the authors try only to correct the functional disturbance. Unfortunately, they have no means of suppressing the attacks of migraine. Perhaps further knowledge of the pathology and etiology will give the hoped-for result.

ARNOLD KNAPP.

Outline of Ocular Refraction. By J. T. Maxwell, M.D. Price, $7.50. Pp. 395, with 135 illustrations. Omaha: Medical Publishing Company, 1937.

This is an exceptionally interesting and valuable book, written by one who has evidently had considerable experience in all the practical details of prescribing glasses, from the initial refraction done in the office to the grinding of the lenses and the fitting of frames.

The chapter on applied optics deals chiefly with the theory of glasses and contains many tables which are of value and are not often found in less practical books, such as the table giving the values of decentration of cylinders at different axes and that giving the effective powers of different types of lenses.

The most stimulating chapter is that on ocular physiology, which is chiefly concerned with the relation of the muscle balance to the static and dynamic refraction. The main thesis of this is that the tonic innervation of the ocular muscles, determined by dissociation tests such as the Maddox rod, is not the final indication for the prescribing of prisms or orthoptic exercises but that the fusional innervation is the factor which should eventually decide what treatment is to be followed. This ties with much of the recent work which has been done on orthoptics, and establishes this form of treatment on a more rational basis. Some may not agree with the reasoning expressed, or with the conclusions drawn in every case, but they cannot help but find the ideas original and stimulating.

The chapters on ophthalmoscopy and perimetry are not as good, but they are more than made up for by the chapter on the trial case and accessories and that on aids to greatly reduced vision. At the end of the book is an excellent appendix on ophthalmic lenses.

The book is concise and well written and will be read with enjoyment by experienced ophthalmologists as well as graduate students.

FRANCIS HEED ADLER.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

Honorary President: Prof. F. de Lapersonne, 217 Fauborg St. Honoré, Paris.
President: Dr. P. Bailliart, 66 Boulevard Saint-Michel, Paris, 6e.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.
All correspondence should be addressed to the President, Dr. P. Bailliart.

International Ophthalmologic Congress

Secretary: Dr. E. Marx, Costzeedijk 316, Rotterdam, Netherlands.

International Organization Against Trachoma

President: Dr. A. F. MacCallan, 33 Welbeck St., London, W., England.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. P. E. H. Adams, 6 Holywell, Oxford.
Secretary: Dr. Thomasina Belt, 13 Mitchell Ave., Jesmond, Newcastle-on-Tyne.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen, Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

German Ophthalmological Society

President: Prof. Lohlein, Jena.
Secretary: Prof. A. Wagenmann, Heidelberg.

Midland Ophthalmological Society

President: Dr. T. E. Ashdown Carr, 34 Charnwood St., Derby, England.
Secretary: T. Harrison Butler, 81 Edmund St., Birmingham, England.
Place: Birmingham and Midland Eye Hospital.

Ophthalmological Society of Egypt

President: Prof. Dr. Sayed Abdel Hamid Soliman Pasha, Faculty of Medicine, Cairo.
Secretary: Dr. Abdel Fattah El Tobgy, 3 Midan Soliman Pasha, Cairo.
Time: March 1938.

Ophthalmological Society of the United Kingdom

President: Mr. Gordon M. Holmes, 9 Wimpole St., London, W. 1.
Secretary: Mr. J. D. M. Cardell, 27 Weymouth St., London, W. 1.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

---

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

OXFORD OPHTHALMOLOGICAL CONGRESS

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Time: July 7-9, 1938.

PALESTINE OPHTHALMOLOGICAL SOCIETY

President: Dr. Arieh Feigenbaum, Abyssinian Str. 15, Jerusalem.
Secretary: Dr. E. Sinai, Tel-Aviv.

POLISH OPHTHALMOLOGICAL SOCIETY

President: Dr. W. Kapuściński, 2 Waly Batorego, Poznań.
Secretary: Dr. J. Sobański, Lindley'a 4, Warsaw.
Place: Lindley'a 4, Warsaw.

ROYAL SOCIETY OF MEDICINE, SECTION OF OPHTHALMOLOGY

President: Dr. Ransom Pickard, 31 E. Southernhay, Exeter, England.
Secretary: Dr. A. Rugg-Gunn, 35 Harley St., London, W. 1.

SOCIÉTÉ FRANÇAISE D'OPHTHALMOLOGIE

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris, 7è.

SOCIETY OF SWEDISH OPHTHALMOLOGISTS

President: Prof. K. G. Ploman, Stockholm, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

TEL-AVIV OPHTHALMOLOGICAL SOCIETY

President: Dr. D. Arieh-Friedman, 96 Allenby Str., Tel-Aviv.
Secretary: Dr. Sadger Max, 9 Bialik Str., Tel-Aviv.

TSINAN OPHTHALMOLOGICAL SOCIETY

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. Derrick T. Vail Jr., 441 Vine St., Cincinnati.
Place: San Francisco. Time: June 13-17, 1938.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY, SECTION ON OPHTHALMOLOGY

President: Dr. Harry S. Gradle, 58 E. Washington St., Chicago.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. Frederick H. Verhoeff, 243 Charles St., Boston.
Secretary-Treasurer: Dr. Eugene M. Blake, 303 Whitney Ave., New Haven, Conn.
Place: San Francisco. Time: June 9-11, 1938.

CANADIAN OPHTHALMOLOGICAL SOCIETY

President: Dr. W. Gordon M. Byers, 1458 Mountain St., Montreal.
Secretary-Treasurer: Dr. Alexander E. MacDonald, 421 Medical Arts Bldg., Toronto.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Secretary: Miss Regina E. Schneider, 50 W. 50th St., New York.

SECTIONAL

CENTRAL WISCONSIN SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. C. Gardner, 11 N. Main St., Fond du Lac.
Secretary: Dr. G. L. McCormick, 626 S. Central Ave., Marshfield.
Place: Marshfield. Time: May 1938.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. Edwin B. Goodall, 101 Bay State Rd., Boston.
Secretary-Treasurer: Dr. William P. Beetham, 5 Bay State Rd., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. William D. Donoher, 1930 Wilshire Blvd., Los Angeles.
Secretary-Treasurer: Dr. C. Allen Dickey, 450 Sutter St., San Francisco.
Place: Victoria, B. C. Time: June 21-24, 1938.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. A. W. Howe, 740 St. Helens Ave., Tacoma, Wash.
Secretary-Treasurer: Dr. Purman Dorman, 1115 Terry Ave., Seattle.
Place: Seattle or Tacoma, Wash. Time: Third Tuesday of each month, except June, July and August.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Frank W. Broderick, 501 Central Trust Bldg., Sterling, Ill.
Secretary-Treasurer: Dr. Thorsten E. Blomberg, 501—7th St., Rockford, Ill.
Place: Rockford, Ill., or Janesville or Beloit, Wis. Time: Third Tuesday of each month.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Secretary-Treasurer: Dr. Andre Cortopassi, 703 Second National Bank Bldg., Saginaw, Mich.
Place: Saginaw or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. J. H. Judd, 107 S. 17th St., Omaha, Neb.
Secretary-Treasurer: Dr. J. C. Decker, 515 Frances Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Grady E. Clay, Medical Arts Bldg., Atlanta, Ga.
Secretary: Dr. John R. Hume, 921 Canal St., New Orleans.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. John Hunter McRae, 26 Sheldon Ave., S. E., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Dewey R. Heetderks, 405 Medical Arts Bldg., Grand Rapids, Mich.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. C. Wearne Beals, Weber Bldg., DuBois.
Secretary-Treasurer: Dr. C. Wearne Beals, Weber Bldg., DuBois.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. John C. Long, 324 Metropolitan Bldg., Denver.
Place: Capitol Life Bldg., Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Charles T. Flynn, 41 Trumbull St., New Haven.
Secretary-Treasurer: Dr. Shirley H. Baron, 309 State St., New London.
Place: New London. Time: February 1938.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. John King, Thomasville.
Secretary-Treasurer: Dr. Mason Baird, 384 Peachtree St., Atlanta.
Place: Augusta. Time: May 1938.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. E. E. Holland, 51 S. 8th St., Richmond.
Secretary: Dr. Marlow W. Manion, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: April 6, 1938.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. H. Lamb, American Bank Bldg., Davenport.
Secretary-Treasurer: Dr. B. M. Merkel, 604 Locust St., Des Moines.
Place: Davenport.

Louisiana-Mississippi Ophthalmological and Otolaryngological Society

President: Dr. C. A. McWilliams, G. and S. I. R. R. Bldg., Gulfport, Miss.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.
Place: New Orleans. Time: Spring, 1938.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. F. N. Smith, Grand Rapids Clinic, Grand Rapids.
Secretary: Dr. Dewey R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

Minnesota Academy of Ophthalmology and Otolaryngology

President: Dr. Walter E. Camp, 1918 Medical Arts Bldg., Minneapolis.
Secretary-Treasurer: Dr. George E. McGeary, 920 Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. Edward S. Murphy, Northern Pacific Hospital, Missoula.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. Oram Kline, 414 Cooper St., Camden.
Secretary: Dr. James S. Shipman, 542 Cooper St., Camden.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. Marvin F. Jones, 121 E. 60th St., New York.
Secretary: Dr. Algernon B. Reese, 73 E. 71st St., New York.
Time: May 10, 1938.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. M. Lilly, 302 Old St., Fayetteville.
Secretary-Treasurer: Dr. Frank C. Smith, 106 W. 7th St., Charlotte.
Place: Charlotte. Time: October.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. Rosenberger, 221—5th St., Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, 514—6th St., Valley City.
Place: Bismarck. Time: May 1938.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. N. Darrell Harvey, 112 Waterman St., Providence.
Secretary-Treasurer: Dr. Linley C. Happ, 124 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. George Truluck, Orangeburg.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Kate Savage Zerfoss, 165—8th Ave., N., Nashville.
Secretary-Treasurer: Dr. W. D. Stinson, 805 Medical Arts Bldg., Memphis.
Place: Nashville. Time: April 12-13, 1938.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. M. H. Hood, 505 Washington St., Portsmouth.
Secretary-Treasurer: Dr. Charles T. St. Clair, 418 Bland St., Bluefield, W. Va.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. George Traugh, 309 Cleveland Ave., Fairmont.
Secretary: Dr. Welch England, 621½ Market St., Parkersburg.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. James A. Fisher, 501 Grand Ave., Asbury Park.
Secretary: Dr. William F. McKim, 488 Sanford Ave., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

Akron Academy of Ophthalmology and Otolaryngology

President: Dr. L. E. Brown, Second National Bldg., Akron.
Secretary-Treasurer: Dr. C. R. Anderson, 106 S. Main St., Akron.
Time: First Monday in January, March, May and November.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. J. Mason Baird, Medical Arts Bldg., Atlanta, Ga.
Secretary: Dr. Alton V. Hallum, 478 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. Time: Second Friday of each month from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Henry F. Graff, 513 N. Charles St., Baltimore.
Secretary: Dr. Frank B. Walsh, Wilmer Institute, Johns Hopkins Hospital, Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. Walter V. Moore, 1 Nevins St., Brooklyn.
Secretary-Treasurer: Dr. Mortimer A. Lasky, 1 Nevins St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Ivan J. Koenig, 40 North St., Buffalo.
Secretary-Treasurer: Dr. Meyer H. Riwchun, 367 Linwood Ave., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Thomas D. Allen, 122 S. Michigan Blvd., Chicago.
Secretary-Treasurer: Dr. Earle B. Fowler, 55 E. Washington St., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati Ophthalmic Club

Chairman: Each member, in rotation.
Secretary-Treasurer: Dr. E. R. Thomas, 819 Carew Tower, Cincinnati.
Place: Holmes Memorial Library, Cincinnati General Hospital. Time: 8:15 p. m., third Monday of each month except June, July and August.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Webb Chamberlin, 7405 Detroit Ave., Cleveland.
Secretary: Dr. Walter H. Rieger, Hanna Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. Paul Moore, Republic Bldg., Cleveland.
Secretary: Dr. G. Leslie Miller, 14805 Detroit Ave., Cleveland.
Time: Second Tuesday in October, December, February and April.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

COLUMBUS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

Chairman: Dr. C. E. Silbernagle, 247 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. D. M. Johnson, 327 E. State St., Columbus, Ohio.
Place: Deshler Wallick Hotel. Time: 6 p. m., first Monday of each month.

CORPUS CHRISTI EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. Edgar G. Mathis, 416 Chaparral St., Corpus Christi, Texas.
Secretary: Dr. E. King Gill, 416 Chaparral St., Corpus Christi, Texas.
Time: Second Thursday of each month from October to May.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Lester H. Quinn, 4105 Live Oak, Dallas, Texas.
Secretary: Dr. J. Dudley Singleton, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DES MOINES ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month from September to May.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. William Fowler, 1424 Maccabee Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

EASTERN NEW YORK EYE, EAR, NOSE AND THROAT ASSOCIATION

President: Dr. J. D. Carroll, 102—3d St., Troy, N. Y.
Secretary-Treasurer: Dr. Joseph L. Holohan, 330 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth, Texas.
Secretary-Treasurer: Dr. Charles R. Lees, 306 W. Broadway, Fort Worth, Texas.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

GRAND RAPIDS EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Dewey R. Heetderks, 405 Medical Arts Bldg., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 116 E. Fulton St., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. L. Allen, 1215 Walker Ave., Houston, Texas.
Secretary: Dr. George C. Farrish, 1625 Main St., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. C. P. Clark, 24 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. O. S. Gilliland, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. John S. Knight, 1103 Grand Ave., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. F. C. Hertzog, 117 E. 8th St., Long Beach, Calif.
Secretary-Treasurer: Dr. Ben K. Parks, 619 Professional Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Isaac H. Jones, 1930 Wilshire Blvd., Los Angeles.
Secretary-Treasurer: Dr. John P. Lordan, 2007 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

LOUISVILLE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. S. Bumgardner, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Max Bornstein, Heyburn Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Earle Breeding, 1801 I St., N. W., Washington.
Secretary: Dr. Elmer Shepherd, 1606—20th St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. Sam H. Sonders, Medical Arts Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. Thomas A. Judge, 735 N. Water St., Milwaukee.
Secretary-Treasurer: Dr. John B. Hitz, 208 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., second Tuesday of each month.

MINNEAPOLIS OPHTHALMOLOGICAL SOCIETY

Chairman: Each member, in alphabetical order.
Secretary: Dr. M. C. Pfunder, 645 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

MONTGOMERY COUNTY MEDICAL SOCIETY

Chairman: Dr. A. G. Farmer, 1040 Fidelity Bldg., Dayton, O.
Secretary-Treasurer: Dr. Rome M. Webster, 663 Reibold Bldg., Dayton, O.
Place: Van Cleve Hotel. Time: 6:30 p. m., bimonthly, first Tuesday from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. Stuart Ramsay, 1496 Mountain St., Montreal, Canada.
Secretary: Dr. J. Rosenbaum, 1396 St. Catherine St., W., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Guy Maness, 119—7th Ave., Nashville, Tenn.
Secretary-Treasurer: Dr. Andrew Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to May.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Society for Clinical Ophthalmology

Chairman: Dr. James W. White, 15 Park Ave., New York.
Secretary: Dr. Rudolf Aebli, 30 E. 40th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

New York Society for Clinical Ophthalmology

President: Dr. Mark J. Schoenberg, 1160 Park Ave., New York.
Secretary: Dr. Jesse Stark, 45 Park Ave., New York.
Place: Squibb Hall, 745—5th Ave. Time: 7 p. m., first Monday of each month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. A. J. Young, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Delbert K. Judd, 1020 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Ophthalmological Society of the University of Pittsburgh

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, 351—5th Ave., Pittsburgh.
Time: Second Monday in November, January, March and May.

Passaic-Bergen Ophthalmological Club

President: Dr. John S. Van Winkle, 297 Broadway, Paterson, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 340 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Secretary: Dr. Edmund B. Spaeth, 1930 Chestnut St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Glendon E. Curry, Westinghouse Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, 351—5th Ave., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. A. F. Bagby, Professional Bldg., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

ROCHESTER EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

ST. LOUIS OPHTHALMIC SOCIETY

President: Dr. Lawrence T. Post, 508 N. Grand Blvd., St. Louis.
Secretary: Dr. Leslie Charles Drews, 508 N. Grand Blvd., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

SAN ANTONIO OPHTHALMOLO-OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Oscar H. Judkins, 414 Navarro St., San Antonio, Texas.
Secretary-Treasurer: Dr. Wilfred E. Muldoon, 414 Navarro St., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

SAN FRANCISCO COUNTY MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Joseph W. Crawford, 490 Post St., San Francisco.
Secretary: Dr. Russell Fletcher, 490 Post St., San Francisco.
Place: Society's Bldg., 2180 Washington St., San Francisco. Time: Fourth Tuesday of every month except May, June, July and December.

SHREVEPORT EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Place: Shreveport Charity Hospital. Time: 7:30 p. m., first Monday of every month except July, August and September.

SPOKANE ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Raymond A. Lower, 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. Louis A. Parsell, Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

SYRACUSE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Gordon D. Hoople, 110 Medical Arts Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. Herbert Katz, 212 Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

TORONTO ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. Samuel Mortimer Lyon, 122 Bloor St., W., Toronto, Canada.
Time: First Monday of each month, November to April.

WASHINGTON, D. C., OPHTHALMOLOGICAL SOCIETY

President: Dr. G. Victor Simpson, 1710 Rhode Island Ave., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Frank D. Costenbader, 1726 I St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.